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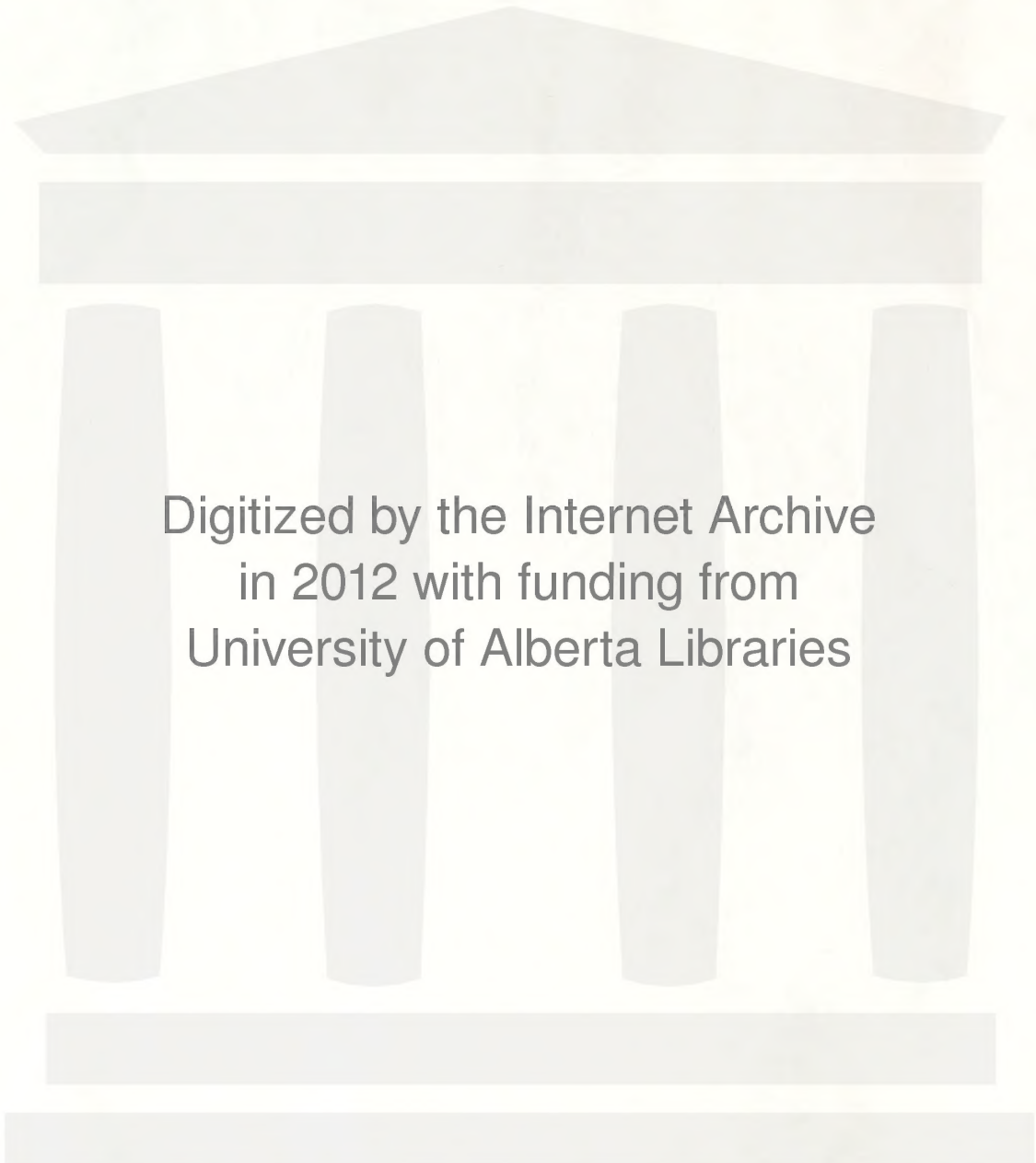

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MATHEMATICS

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Applied Mathematics 10–20–30

Pure Mathematics 10–20–30

Mathematics 31

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★ The **revised** Mathematics 14–24 program of studies has interim approval effective September 2001.

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APPLIED MATHEMATICS 10–20–30

PROGRAM RATIONALE AND PHILOSOPHY

Applied mathematics gives students a clearer picture of why they are learning mathematics, and it motivates them in learning. Students experience mathematics as being dynamic and useful in their careers and everyday life.

The approach used in applied mathematics is primarily data driven, using numerical and geometrical problem-solving techniques. As a way of increasing relevance, students collect data in experiments and activities and develop mathematical concepts from analyses of the data. Algebraic constructs are addressed as a result of activities that students perform or as a result of experiences in which they are engaged.

In applied mathematics, students are required to demonstrate effective communication skills. This includes understanding, using and interpreting various media types. Students are expected to make efficient use of both oral and written communication.

When accomplishing program or curriculum outcomes, students come to understand that mathematics is much more than theory emphasizing a set of algorithms. They learn that mathematics is a powerful set of processes, models and skills that can be used to solve nonroutine problems, both in and out of the classroom.

Applied mathematics tasks are designed to develop student flexibility and responsibility. Students show flexibility by working individually and in cooperative groups and by working on nonroutine problems and projects. Students show responsibility as they work independently and explore connections among other mathematical areas, other school subjects and real-life applications. Students need support in developing flexibility and responsibility.

Technology is an integral part of applied mathematics. The graphing calculator is the primary technological tool used by students for mathematical exploration, modelling and problem solving. The use of spreadsheets, with functions defined by the student, is expected in all contexts. Technology is an effective and integral part of learning and assessment, both formative and summative, in applied mathematics.

The Applied Mathematics 10–20–30 program is made up of outcomes, some of which are common to both the applied and pure mathematics programs. The approach to the common outcomes varies from the applied to the pure programs, but the critical skill of using mathematics to find solutions to real-life situations is developed in both programs.

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LEARNER OUTCOMES

The general outcomes for the complete Applied Mathematics 10–20–30 program are shown first. The general outcomes are arranged in order of strand and substrand, following the order—Number, Patterns and Relations, Shape and Space, Statistics and Probability—established in *The Common Curriculum Framework for K–12 Mathematics Grade 10 to Grade 12: Western Canadian Protocol for Collaboration in Basic Education*, 1996. This listing is not intended as a sequence for instruction, and the number of outcomes is not an indication of the relative time to be spent on each of the strands. For each of the three courses, the learner outcomes follow the format of general outcomes and specific outcomes. The specific outcomes are arranged according to topics and in the order followed in the companion documents, *Outcomes with Assessment Standards for Applied Mathematics 10*, *Outcomes with Assessment Standards for Applied Mathematics 20* and the *Diploma Examination Bulletin for Applied Mathematics 30*.

MATHEMATICAL PROCESSES

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and to encourage lifelong learning in mathematics.

Each specific outcome incorporates one or more of these seven interrelated mathematical processes that are intended to permeate teaching and learning.

- *Communication* [C] – communicate mathematically
- *Connections* [CN] – connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines
- *Estimation and Mental Mathematics* [E] – use estimation and mental mathematics where appropriate
- *Problem Solving* [PS] – relate and apply new mathematical knowledge through problem solving
- *Reasoning* [R] – reason and justify thinking
- *Technology* [T] – select and use appropriate technologies as tools to solve problems
- *Visualization* [V] – use visualization to assist in processing information, making connections and solving problems

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GENERAL OUTCOMES—Number Strand

Substrand	Applied Mathematics 10–20–30
Number Concepts (NC) *Students will:* • use numbers to describe quantities • represent numbers in multiple ways.	Analyze the numerical data in a table for trends, patterns and interrelationships. [Applied Mathematics 10] Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system. [Applied Mathematics 10]
Number Operations (NO) *Students will:* • demonstrate an understanding of and proficiency with calculations • decide which arithmetic operation or operations can be used to solve a problem, and then solve the problem.	Use basic arithmetic operations on real numbers to solve problems. [Applied Mathematics 10] Describe and apply arithmetic operations on tables to solve problems, using technology as required. [Applied Mathematics 10] Solve consumer problems, using arithmetic operations. [Applied Mathematics 20] Describe and apply operations on matrices to solve problems, using technology as required. [Applied Mathematics 30] Design or use a spreadsheet to make and justify financial decisions. [Applied Mathematics 30]

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GENERAL OUTCOMES—Patterns and Relations Strand

Substrand	Applied Mathematics 10–20–30
Patterns (P) *Students will:* • use patterns to describe the world and to solve problems.	Generate and analyze cyclic, recursive and fractal patterns. [Applied Mathematics 30]
Variables and Equations (VE) *Students will:* • represent algebraic expressions in multiple ways.	Represent and analyze situations that involve expressions, equations and inequalities. [Applied Mathematics 20] Use linear programming to solve optimization problems. [Applied Mathematics 20]
Relations and Functions (RF) *Students will:* • use algebraic and graphical models to generalize patterns, make predictions and solve problems.	Examine the nature of relations with an emphasis on functions. [Applied Mathematics 10] Represent data, using linear function models. [Applied Mathematics 10] Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate. [Applied Mathematics 20]

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GENERAL OUTCOMES—Shape and Space Strand

Substrand	Applied Mathematics 10–20–30
Measurement (M) *Students will:* • describe and compare everyday phenomena, using either direct or indirect measurement.	Demonstrate an understanding of scale factors and their interrelationship with the dimensions of similar shapes and objects. [Applied Mathematics 10 and 20] Solve problems involving triangles, including those found in 3-D and 2-D applications. [Applied Mathematics 10] Use measuring devices to make estimates and to perform calculations in solving problems. [Applied Mathematics 10 and 20] Analyze objects, shapes and processes to solve cost and design problems. [Applied Mathematics 30]
3-D Objects and 2-D Shapes (3D) *Students will:* • describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	Solve coordinate geometry problems involving lines and line segments. [Applied Mathematics 10] Develop and apply the geometric properties of circles and polygons to solve problems. [Applied Mathematics 20] Solve problems involving polygons and vectors, including both 3-D and 2-D applications. [Applied Mathematics 30]

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GENERAL OUTCOMES—Statistics and Probability Strand

Substrand	Applied Mathematics 10–20–30
Data Analysis (DA) *Students will:* • collect, display and analyze data to make predictions about a population.	Apply line-fitting and correlation techniques to analyze experimental results. [Applied Mathematics 10] Analyze graphs or charts of given situations to derive specific information. [Applied Mathematics 20]
Chance and Uncertainty (CU) *Students will:* • use experimental or theoretical probability to represent and solve problems involving uncertainty.	Use normal and binomial probability distributions to solve problems involving uncertainty. [Applied Mathematics 30] Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations. [Applied Mathematics 30] Model the probability of a compound event, and solve problems based on the combining of simpler probabilities. [Applied Mathematics 30]

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Topic 1: Measurement

C	Communication	**PS** Problem Solving
CN	Connections	**R** Reasoning
E	Estimation and Mental Mathematics	**T** Technology
		V Visualization

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 1.1 to 1.6 are exclusive to Applied Mathematics 10.
Use measuring devices to make estimates and to perform calculations in solving problems.	(M) 1.1 Select and apply appropriate instruments, units of measure (in SI and imperial systems) and measurement strategies to find lengths, areas and volumes. [E, PS, T]
	(M) 1.2 Analyze the limitations of measuring instruments and measurement strategies, using the concepts of precision and accuracy. [C, R]
	(M) 1.3 Solve problems involving length, area, volume, time, mass and rates derived from these. [C, E, PS]
	(M) 1.4 Interpret drawings, and use the information to solve problems. [C, PS, V]
Demonstrate an understanding of scale factors and their interrelationship with the dimensions of similar shapes and objects.	(M) 1.5 Calculate the volume and surface area of a sphere, using formulas that are provided. [CN, PS, V]
	(M) 1.6 Determine the relationships among linear scale factors, areas, surface areas and volumes of similar figures and objects. [CN, PS, R, V]

NC	Number Concepts	**VE**	Variables and Equations	**3D**	3-D Objects and 2-D Shapes
NO	Number Operations	**RF**	Relations and Functions	**DA**	Data Analysis
P	Patterns	**M**	Measurement	**CU**	Chance and Uncertainty

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Topic 2: Number Patterns in Tables

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 2.1 to 2.8 are similar to related outcomes in Pure Mathematics 10. Outcome 2.9 is exclusive to Applied Mathematics 10.
Analyze the numerical data in a table for trends, patterns and interrelationships.	(NC) 2.1 Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are not related recursively (not calculated from previous data). [C, CN]
	(NC) 2.2 Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are related recursively (calculated from previous data). [C, CN]
Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system.	(NC) 2.3 Classify numbers as natural, whole, integer, rational or irrational; and show that these number sets are nested within the real number system. [C, R, V]
	(NC) 2.4 Use approximate representations of irrational numbers. [R, T]

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General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Use basic arithmetic operations on real numbers to solve problems.	(NO) 2.5 Communicate a set of instructions used to solve an arithmetic problem, including instructions that follow the algebraic format of a formula. [C]
	(NO) 2.6 Perform arithmetic operations on irrational numbers, using appropriate decimal approximations. [E, T]
Describe and apply arithmetic operations on tables to solve problems, using technology as required.	(NO) 2.7 Create and modify tables from both recursive and nonrecursive situations. [PS, T, V]
	(NO) 2.8 Use and modify a spreadsheet template to model recursive situations. [PS, T, V]
	(NO) 2.9 Solve problems involving combinations of tables, using: • addition or subtraction of two tables • multiplication of a table by a real number • algebraic processes to build spreadsheet functions and templates. [PS, T, V]

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Topic 3: Relations and Functions

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Examine the nature of relations with an emphasis on functions.	Outcomes 3.1 to 3.6 are similar to related outcomes in Pure Mathematics 10. (RF) 3.1 Plot linear and nonlinear data, using appropriate scales. [C, V] (RF) 3.2 Represent data, using function models. [CN, PS, V] (RF) 3.3 Use a graphing tool to draw the graph of a function from its equation. [C, T, V] (RF) 3.4 Describe a function in terms of: • ordered pairs • a rule, in word or equation form • a graph. [C, CN, V] (RF) 3.5 Use function notation to evaluate and represent functions, incorporating contextually appropriate variables such as volume as a function of time in the form $V = V(t)$ rather than $y = f(x)$. [C, PS] (RF) 3.6 Determine the domain and range of a relation from its graph. [PS, V]

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Topic 4: Line Segments

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve coordinate geometry problems involving lines and line segments.	Outcomes 4.1 to 4.4 are similar to related outcomes in Pure Mathematics 10. (3D) 4.1 Solve problems involving distances between points in the coordinate plane, including the use of the distance formula $\overline{AB} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. [PS, V] (3D) 4.2 Solve problems involving midpoints of line segments, including the use of the midpoint formula $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$. [PS] (3D) 4.3 Solve problems involving rise, run and slope of line segments, including the use of $m(AB) = \frac{y_2 - y_1}{x_2 - x_1}$. [PS, V] (3D) 4.4 Solve problems using slopes of: • parallel lines • perpendicular lines. [CN, PS, V]

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Topic 5: Linear Functions

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 5.1 and 5.5 to 5.9 are exclusive to Applied Mathematics 10. Outcomes 5.2 to 5.4 are similar to related outcomes in Pure Mathematics 10.
Examine the nature of relations with an emphasis on functions.	(RF) 5.1 Rewrite linear expressions in terms of the dependent (responding) variable. [C, R, V]
	(RF) 5.2 Determine the following characteristics of the graph of a linear function, given its equation in any of the forms $y = mx + b$, $y - y_1 = m(x - x_1)$, $Ax + By + C = 0$, $Ax + By = C$: • intercepts • slope • domain • range. [PS, V]
	(RF) 5.3 Determine the equation of a line, given information that uniquely determines the line. [PS, V]
Represent data, using linear function models.	(RF) 5.4 Use variation and arithmetic sequences as applications of linear functions (use of algebraic and technological means is appropriate). [CN, PS, V]

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General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Apply line-fitting and correlation techniques to analyze experimental results.	(DA) 5.5 Determine the equation of a line of best fit, using: • estimate of slope and one point • median–median method • least squares method with technology. [CN, PS, T, V] (DA) 5.6 Use best-fit linear equations and their associated graphs to make predictions and solve problems. [C, CN, PS, T, V] (DA) 5.7 Explain the significance of the parameters a and b in the best-fit equation $y = ax + b$. [C, CN, R, V] (DA) 5.8 Use technological devices to determine the correlation coefficient r. [T] (DA) 5.9 Interpret the correlation coefficient r and its limitations for varying problem situations, using relevant scatterplots. [C, R, V]

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Topic 6: Trigonometry

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve problems involving triangles, including those found in 3-D and 2-D applications.	Outcomes 6.1 to 6.3 are similar to related outcomes in Pure Mathematics 10. (M) 6.1 Solve problems involving two right triangles. [CN, PS, V] (M) 6.2 Extend the concepts of sine and cosine for angles from 0° to 180°. [R, T, V] (M) 6.3 Apply the sine and cosine laws, excluding the ambiguous case, to solve problems. [CN, PS, V]

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APPLIED MATHEMATICS 20

Topic 1: Graphing and Design

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Analyze graphs or charts of given situations to derive specific information.	Outcomes 1.1 to 1.3 are exclusive to Applied Mathematics 20. (DA) 1.1 Extract information from given graphs of discrete or continuous data, using: • time series • glyphs (custom pictorial representations) • continuous data • contour lines. [C, CN, E, PS, R, V] (DA) 1.2 Draw and validate inferences, including interpolations and extrapolations, from graphical and tabular data. [CN, E, PS, V] (DA) 1.3 Design different ways of presenting data and analyzing results, by focusing on the truthful display of data and the clarity of presentation. [C, CN, T, V]

NC	Number Concepts	**VE**	Variables and Equations	**3D**	3-D Objects and 2-D Shapes
NO	Number Operations	**RF**	Relations and Functions	**DA**	Data Analysis
P	Patterns	**M**	Measurement	**CU**	Chance and Uncertainty

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Topic 2: Regression and Nonlinear Equations

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 2.1 and 2.2 are similar to related outcomes in Pure Mathematics 20. Outcomes 2.3 to 2.5 are exclusive to Applied Mathematics 20.
Represent and analyze situations that involve expressions, equations and inequalities.	(VE) 2.1 Solve nonlinear equations, using a graphing tool. [CN, T, V]
Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.	(RF) 2.2 Determine the following characteristics of the graph of a quadratic function: • vertex • domain and range • axis of symmetry • intercepts. [C, PS, T, V]
Analyze graphs or charts of given situations to derive specific information.	(DA) 2.3 Collect experimental data, graph the data using technology, and represent the data with best-fit exponential or quadratic functions of the form: • $y = ab^x$ • $y = ax^2 + bx + c$. [C, CN, PS, T, V]
Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.	(RF) 2.4 Use best-fit exponential and quadratic functions and their associated graphs to make predictions and solve problems. [C, CN, PS, T, V]
	(RF) 2.5 Explain the significance of the parameters in the equations for exponential and quadratic functions of the form: • $y = ab^x \rightarrow$ parameters a, b • $y = ax^2 + bx + c \rightarrow$ parameters a, c. [C, CN, R, V]

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Topic 3: Linear Systems and Programming

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 3.1 and 3.2 are similar to related outcomes in Pure Mathematics 20. Outcomes 3.3 to 3.6 are exclusive to Applied Mathematics 20.
Represent and analyze situations that involve expressions, equations and inequalities.	(VE) 3.1 Graph linear inequalities in two variables, including the conversion of $Ax + By + C = 0$ into $y =$ form. [PS, V]
	(VE) 3.2 Solve systems of linear equations, in two variables: • algebraically (elimination and substitution) • graphically. [CN, PS, T, V]
Use linear programming to solve optimization problems.	(VE) 3.3 Use expressions containing variables to describe problem contexts and solutions. [C, CN, PS, R]
	(VE) 3.4 Solve, graphically, systems of linear inequalities in two variables, using technology. [CN, PS, T, V]
	(VE) 3.5 Design and solve linear and nonlinear systems, in two variables, to model problem situations. [C, CN, PS, R, V]
	(VE) 3.6 Apply linear programming to find optimal solutions to decision-making problems. [C, PS, R, T, V]

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Topic 4: Finance

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve consumer problems, using arithmetic operations.	Outcomes 4.1 to 4.4 are similar to related outcomes in Pure Mathematics 20. (NO) 4.1 Solve consumer problems, including: • wages earned in various situations • property taxation • exchange rates • unit prices. [CN, E, PS, R, T] (NO) 4.2 Reconcile financial statements, which may include: • cheque books and bank statements • credit card statements • loan statements. [CN, PS, T] (NO) 4.3 Solve budget problems, using graphs and tables to communicate solutions. [C, PS, T, V] (NO) 4.4 Solve investment and credit problems involving simple and compound interest. [CN, PS, T]

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Topic 5: Circle Geometry and Design

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
	Outcome 5.1 is similar to a related outcome in Pure Mathematics 20. Outcome 5.2 is exclusive to Applied Mathematics 20.
Develop and apply the geometric properties of circles and polygons to solve problems.	(3D) 5.1 Use technology and measurement to confirm and apply the following properties to particular cases: • the perpendicular from the centre of a circle to a chord bisects the chord • the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc • the inscribed angles subtended by the same arc are congruent • the angle inscribed in a semicircle is a right angle • the opposite angles of a cyclic quadrilateral are supplementary • a tangent to a circle is perpendicular to the radius at the point of tangency • the tangent segments to a circle, from any external point, are congruent • the sum of the interior angles of an n-sided polygon is $(2n - 4)$ right angles. [PS, R, T, V]
	(3D) 5.2 Use properties of circles and polygons to solve design and layout problems. [CN, PS, V]

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Topic 6: Measurement and Design

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 6.1 to 6.4 are exclusive to Applied Mathematics 20.
Demonstrate an understanding of scale factors and their interrelationship with the dimensions of similar shapes and objects.	(M) 6.1 Enlarge or reduce a dimensioned object, according to a specified scale. [C, CN, PS, V]
Use measuring devices to make estimates and to perform calculations in solving problems.	(M) 6.2 Calculate maximum and minimum values, using tolerances, for lengths, areas and volumes. [PS, R, V]
	(M) 6.3 Solve problems involving percentage error when input variables are expressed with percentage errors, using either formulas or first principles. [PS, R, V]
	(M) 6.4 Design an appropriate measuring process or device to solve a problem. [E, PS, V]

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Topic 1: Matrices and Pathways

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 1.1 and 1.2 are similar to related outcomes in Pure Mathematics 30. Outcomes 1.3 and 1.4 are exclusive to Applied Mathematics 30.
Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations.	(CU) 1.1 Solve pathway problems, interpreting and applying any constraints. [PS, R]
	(CU) 1.2 Use the fundamental counting principle to determine the number of different ways to perform multistep operations. [PS, R]
Describe and apply operations on matrices to solve problems, using technology as required.	(NO) 1.3 Perform, using technology only for larger matrices, the matrix operations of addition, subtraction, matrix multiplication and multiplication by a scalar. [C, E, R, T, V]
	(NO) 1.4 Model and solve consumer and network problems, performing matrix operations and using algebraic solution strategies as needed. [CN, PS, T, V]

NC	Number Concepts	**VE**	Variables and Equations	**3D**	3-D Objects and 2-D Shapes
NO	Number Operations	**RF**	Relations and Functions	**DA**	Data Analysis
P	Patterns	**M**	Measurement	**CU**	Chance and Uncertainty

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Topic 2: Statistics and Probability

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
	Outcomes 2.1 and 2.2 are similar to related outcomes in Pure Mathematics 30. Outcomes 2.3 to 2.7 are exclusive to Applied Mathematics 30.
Use normal and binomial probability distributions to solve problems involving uncertainty.	(CU) 2.1 Find the population standard deviation of a data set, using technology. [CN, E, T, V]
	(CU) 2.2 Use z-scores to solve problems related to the normal distribution. [PS, R, T, V]
	(CU) 2.3 Use the normal approximation to the binomial distribution to solve problems involving confidence intervals for large-sample binomial experiments. [CN, E, PS, T]
Model the probability of a compound event, and solve problems based on the combining of simpler probabilities.	(CU) 2.4 Construct a sample space for two or three events. [PS, R, V]
	(CU) 2.5 Classify events as independent or dependent. [C]
	(CU) 2.6 Use expressions for $P(A \text{ and } B)$ to solve problems involving independent and dependent events. [CN, PS, R]
	(CU) 2.7 Solve problems using the probabilities of mutually exclusive and complementary events. [CN, PS, R]

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Topic 3: Finance

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Design or use a spreadsheet to make and justify financial decisions.	Outcomes 3.1 to 3.4 are exclusive to Applied Mathematics 30. (NO) 3.1 Design a financial spreadsheet template to allow users to input their own variables. [C, PS, T] (NO) 3.2 Analyze the costs and benefits of renting or buying an increasing asset, such as a home. [C, CN, PS, T] (NO) 3.3 Analyze the costs and benefits of leasing or buying a decreasing asset, such as a vehicle or a computer. [C, CN, PS, T] (NO) 3.4 Analyze an investment portfolio, applying such concepts as interest rate, rate of return and total return. [C, CN, PS, T]

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Topic 4: Cyclic, Recursive and Fractal Patterns

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Generate and analyze cyclic, recursive and fractal patterns.	Outcomes 4.1 to 4.6 are exclusive to Applied Mathematics 30, although 4.1 and 4.3 are closely related to outcomes in Pure Mathematics 30. (P) 4.1 Collect sinusoidal data, graph the data using technology, and represent the data with a best-fit equation of the form: • $y = a \sin(bx + c) + d$. [C, CN, PS, T, V] (P) 4.2 Use best-fit sinusoidal equations, and their associated graphs, to make predictions by interpolation and extrapolation. [C, CN, PS, T] (P) 4.3 Describe periodic events, including those represented by sinusoidal curves, using the terms amplitude, period, maximum and minimum values, and vertical and horizontal shift, and relating these terms to the parameters a, b, c and d described in 4.1. [C, V] (P) 4.4 Use technology to generate and graph sequences that model real-life phenomena. [PS, T, V] (P) 4.5 Use technology to construct a fractal pattern by repeatedly applying a procedure to a geometric figure. [CN, R, T, V] (P) 4.6 Use the concept of self-similarity to compare and/or predict the perimeters, areas and volumes of fractal patterns. [CN, R, T, V]

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Topic 5: Vectors

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
	The standards statements include the correspondence between Topic 5 of Applied Mathematics 30 and the vectors section of Physics 20.
Solve problems involving polygons and vectors, including both 3-D and 2-D applications.	(3D) 5.1 Use appropriate terminology to describe: • vector quantities • scalar quantities. [C, CN]
	(3D) 5.2 Assign meaning to the multiplication of a vector by a scalar. [CN]
	(3D) 5.3 Determine the magnitude and direction of a resultant vector, using triangle or parallelogram methods. [CN, R, T, V]
	(3D) 5.4 Model and solve problems in 2-D and simple 3-D, using vector diagrams and technology. [CN, PS, T, V]

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Topic 6: Design

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Analyze objects, shapes and processes to solve cost and design problems.	Outcomes 6.1 to 6.4 are exclusive to Applied Mathematics 30. (M) 6.1 Use dimensions and unit prices to solve problems involving perimeter, area and volume. [E, PS, V] (M) 6.2 Solve problems involving estimation and cost for objects, shapes or processes when a design is given. [C, E, PS] (M) 6.3 Use appropriate variables to design an object, shape, layout or process within a specified budget. [C, PS, R, V] (M) 6.4 Use mathematical models to estimate the solutions to complex measurement problems. [E, V]

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PURE MATHEMATICS 10–20–30

PROGRAM RATIONALE AND PHILOSOPHY

Pure mathematics emphasizes mathematical theory and the testing of mathematical hypotheses. The pure mathematics approach, which is often deductive and symbolic, endeavours to show that concepts are valid all the time, or valid within a well-defined set of restrictions. Real-life problems are then presented in order for students to apply previously learned mathematical concepts and procedures. Students will make use of algebra and graphing to solve problems. Algebra is taught both on a "when needed basis" and for its own sake.

Students are required to demonstrate effective communication skills. This includes understanding, using and interpreting various mathematical concepts and processes. When accomplishing program or curriculum outcomes, students will be expected to explain, to illustrate, to reason and to make connections. Multiple solution strategies to problems and problem contexts will be expected as students work through both routine and nonroutine problems.

Students will be expected to take responsibility for their learning as they work both independently and in groups. Tasks vary from short procedural items, which help students develop skills in the language of mathematics, to longer tasks that require students to test either subtle conjectures or apply mathematical knowledge to nonroutine, real-life problems.

Technology is a part of pure mathematics. The graphing calculator is the primary technological tool used by students for mathematical exploration, modelling and problem solving. The use of spreadsheets, with functions defined by the student, can be profitable in many contexts.

The Pure Mathematics 10–20–30 program is made up of outcomes, some of which are common to both the pure and applied mathematics programs. The approach to the common outcomes varies from the pure to the applied programs, but the critical skill of using mathematics to find solutions to real-life situations is developed in both programs.

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LEARNER OUTCOMES

The general outcomes for the complete Pure Mathematics 10–20–30 program are shown first. The general outcomes are arranged in order of strand and substrand, following the order—Number, Patterns and Relations, Shape and Space, Statistics and Probability—established in *The Common Curriculum Framework for K–12 Mathematics Grade 10 to Grade 12: Western Canadian Protocol for Collaboration in Basic Education*, 1996. This listing is not intended as a sequence for instruction, and the number of outcomes is not an indication of the relative time to be spent on each of the strands. For each of the three courses, the learner outcomes follow the format of general outcomes and specific outcomes. The specific outcomes are arranged according to topics and in the order followed in the companion documents, *Outcomes with Assessment Standards for Pure Mathematics 10*, *Outcomes with Assessment Standards for Pure Mathematics 20* and the *Diploma Examination Bulletin for Pure Mathematics 30*.

MATHEMATICAL PROCESSES

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and to encourage lifelong learning in mathematics.

Each specific outcome incorporates one or more of these seven interrelated mathematical processes that are intended to permeate teaching and learning.

- *Communication* [C] – communicate mathematically
- *Connections* [CN] – connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines
- *Estimation and Mental Mathematics* [E] – use estimation and mental mathematics where appropriate
- *Problem Solving* [PS] – relate and apply new mathematical knowledge through problem solving
- *Reasoning* [R] – reason and justify thinking
- *Technology* [T] – select and use appropriate technologies as tools to solve problems
- *Visualization* [V] – use visualization to assist in processing information, making connections and solving problems

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GENERAL OUTCOMES—Number Strand

Substrand	Pure Mathematics 10–20–30
Number Concepts (NC) *Students will:* • use numbers to describe quantities • represent numbers in multiple ways.	Analyze the numerical data in a table for trends, patterns and interrelationships. [Pure Mathematics 10] Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system. [Pure Mathematics 10]
Number Operations (NO) *Students will:* • demonstrate an understanding of and proficiency with calculations • decide which arithmetic operation or operations can be used to solve a problem, and then solve the problem.	Use basic arithmetic operations on real numbers to solve problems. [Pure Mathematics 10] Describe and apply arithmetic operations on tables to solve problems, using technology as required. [Pure Mathematics 10] Use exact values, arithmetic operations and algebraic operations on real numbers to solve problems. [Pure Mathematics 10] Solve consumer problems, using arithmetic operations. [Pure Mathematics 20]

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GENERAL OUTCOMES—Patterns and Relations Strand

Substrand	Pure Mathematics 10–20–30
Patterns (P) *Students will:* • use patterns to describe the world and to solve problems.	Generate and analyze number patterns. [Pure Mathematics 10] Apply the principles of mathematical reasoning to solve problems and to justify solutions. [Pure Mathematics 20] Generate and analyze exponential patterns. [Pure Mathematics 30]
Variables and Equations (VE) *Students will:* • represent algebraic expressions in multiple ways.	Generalize operations on polynomials to include rational expressions. [Pure Mathematics 10] Represent and analyze situations that involve expressions, equations and inequalities. [Pure Mathematics 20] Solve exponential, logarithmic and trigonometric equations and identities. [Pure Mathematics 30]
Relations and Functions (RF) *Students will:* • use algebraic and graphical models to generalize patterns, make predictions and solve problems.	Examine the nature of relations with an emphasis on functions. [Pure Mathematics 10 and 20] Represent data, using linear function models. [Pure Mathematics 10] Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate. [Pure Mathematics 20] Represent and analyze exponential and logarithmic functions, using technology as appropriate. [Pure Mathematics 30] Represent and analyze trigonometric functions, using technology as appropriate. [Pure Mathematics 30]

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GENERAL OUTCOMES—Shape and Space Strand

Substrand	Pure Mathematics 10–20–30
Measurement (M) *Students will:* • describe and compare everyday phenomena, using either direct or indirect measurement.	Solve problems involving triangles, including those found in 3-D and 2-D applications. [Pure Mathematics 10]
3-D Objects and 2-D Shapes (3D) *Students will:* • describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	Solve coordinate geometry problems involving lines and line segments. [Pure Mathematics 10] Solve coordinate geometry problems involving lines and line segments, and justify the solutions. [Pure Mathematics 20] Develop and apply the geometric properties of circles and polygons to solve problems. [Pure Mathematics 20] Classify conic sections, using their shapes and equations. [Pure Mathematics 30]
Transformations (TR) *Students will:* • perform, analyze and create transformations.	Perform, analyze and create transformations of functions and relations that are described by equations or graphs. [Pure Mathematics 30]

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GENERAL OUTCOMES—Statistics and Probability Strand

Substrand	Pure Mathematics 10–20–30
Data Analysis (DA) *Students will:* • collect, display and analyze data to make predictions about a population.	Implement and analyze sampling procedures, and draw appropriate inferences from the data collected. [Pure Mathematics 10]
Chance and Uncertainty (CU) *Students will:* • use experimental or theoretical probability to represent and solve problems involving uncertainty.	Use normal and binomial probability distributions to solve problems involving uncertainty. [Pure Mathematics 30] Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations. [Pure Mathematics 30] Model the probability of a compound event, and solve problems based on the combining of simpler probabilities. [Pure Mathematics 30]

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Topic 1: Sequences and Data Tables

C Communication
CN Connections
E Estimation and Mental Mathematics
PS Problem Solving
R Reasoning
T Technology
V Visualization

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Analyze the numerical data in a table for trends, patterns and interrelationships.	(NC) 1.1 Use words and algebraic expressions to describe the data and the interrelationships in a given table with rows that are not related recursively (not calculated from previous data). [C, CN]
	(NC) 1.2 Use words and algebraic expressions to describe the data and the interrelationships in a given table with rows that are related recursively (calculated from previous data). [C, CN]
Implement and analyze sampling procedures, and draw appropriate inferences from the data collected.	(DA) 1.3 Choose, justify and apply sampling techniques that will result in an appropriate, unbiased sample from a given population. [C, PS, R]
	(DA) 1.4 Defend or oppose inferences and generalizations about populations, based on data from samples. [C, PS, R]
Describe and apply arithmetic operations on tables to solve problems, using technology as required.	(NO) 1.5 Create and modify tables from both recursive and nonrecursive situations. [PS, T, V]
	(NO) 1.6 Use and modify a spreadsheet template to model recursive situations. [PS, T, V]

(continued)

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations
RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes
TR Transformations
DA Data Analysis
CU Chance and Uncertainty

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Topic 1: Sequences and Data Tables (continued)

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Generate and analyze number patterns.	(P) 1.7 Generate number patterns exhibiting arithmetic growth. [E, R]
	(P) 1.8 Use expressions to represent general terms and sums for arithmetic growth, and apply these expressions to solve problems. [CN, PS, R, T]
	(P) 1.9 Generate number patterns exhibiting geometric growth. [E, R]

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Topic 2: Algebraic Expressions

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Generalize operations on polynomials to include rational expressions.	(VE) 2.1 Factor polynomial expressions of the form $ax^2 + bx + c$, and $a^2x^2 - b^2y^2$. [E] (VE) 2.2 Find the product of polynomials. [E, R] (VE) 2.3 Divide an integral polynomial by a binomial, and express the result in the forms: • $\frac{P}{D} = Q + \frac{R}{D}$ • $P = DQ + R$ • $P(x) = D(x)Q(x) + R$. [E, R] (VE) 2.4 Determine equivalent forms of single-variable rational expressions with polynomial numerators, and denominators that are monomials, binomials or trinomials that can be factored. [PS, R] (VE) 2.5 Determine the nonpermissible values for the variable in single-variable rational expressions. [C, CN] (VE) 2.6 Perform the operations of addition, subtraction, multiplication and division on single-variable rational expressions. [E, R] (VE) 2.7 Find and verify the solutions of rational equations that reduce to linear equations. [CN, PS]

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Topic 3: Line Segments and Graphs

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Examine the nature of relations with an emphasis on functions.	(RF) 3.1 Plot linear and nonlinear data, using appropriate scales. [C, V]
Solve coordinate geometry problems involving lines and line segments.	(3D) 3.2 Solve problems involving distances between points in the coordinate plane. [PS, V]
	(3D) 3.3 Solve problems involving midpoints of line segments. [PS]
	(3D) 3.4 Solve problems involving rise, run and slope of line segments. [PS, V]
	(3D) 3.5 Determine the equation of a line, given information that uniquely determines the line. [PS, V]
	(3D) 3.6 Solve problems using slopes of: • parallel lines • perpendicular lines. [CN, PS, V]

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Topic 4: Relations and Functions

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Examine the nature of relations with an emphasis on functions.	(RF) 4.1 Represent data, using function models. [CN, PS, V] (RF) 4.2 Use a graphing tool to draw the graph of a function from its equation. [C, T, V] (RF) 4.3 Describe a function in terms of: • ordered pairs • a rule, in word or equation form • a graph. [C, CN, V] (RF) 4.4 Use function notation to evaluate and represent functions. [C, PS] (RF) 4.5 Determine the domain and range of a relation from its graph. [PS, V] (RF) 4.6 Determine the following characteristics of the graph of a linear function, given its equation: • intercepts • slope • domain • range. [PS, V]

(continued)

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Topic 4: Relations and Functions (continued)

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Represent data, using linear function models.	(RF) 4.7 Use direct variation, partial variation and arithmetic sequences as applications of linear functions. [CN, PS, V]
Generate and analyze number patterns.	(P) 4.8 Relate arithmetic sequences to linear functions defined over the natural numbers. [CN]

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Topic 5: Exponents and Radicals

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system.	(NC) 5.1 Classify numbers as natural, whole, integer, rational or irrational, and show that these number sets are nested within the real number system. [C, R, V]
	(NC) 5.2 Use approximate representations of irrational numbers. [R, T]
Use basic arithmetic operations on real numbers to solve problems.	(NO) 5.3 Communicate a set of instructions used to solve an arithmetic problem. [C]
	(NO) 5.4 Perform arithmetic operations on irrational numbers, using appropriate decimal approximations. [E, T]
Use exact values, arithmetic operations and algebraic operations on real numbers to solve problems.	(NO) 5.5 Explain and apply the exponent laws for powers of numbers and for variables with rational exponents. [C, E]
	(NO) 5.6 Perform operations on irrational numbers of monomial and binomial form, using exact values. [E]

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Topic 6: Measurement and Trigonometry

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve problems involving triangles, including those found in 3-D and 2-D applications.	(M) 6.1 Solve problems involving two right triangles. [CN, PS, V] (M) 6.2 Extend the concepts of sine and cosine for angles from 0° to 180°. [R, T, V] (M) 6.3 Apply the sine and cosine laws, excluding the ambiguous case, to solve problems. [CN, PS, V]

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Topic 1: Linear and Nonlinear Systems

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Represent and analyze situations that involve expressions, equations and inequalities.	(VE) 1.1 Graph linear inequalities, in two variables. [PS, V] (VE) 1.2 Solve systems of linear equations, in two variables: • algebraically (elimination and substitution) • graphically. [CN, PS, T, V] (VE) 1.3 Determine the solution to a system of nonlinear equations, using technology as appropriate. [PS, T, V] (VE) 1.4 Solve systems of linear equations, in three variables: • algebraically • with technology. [CN, PS, T, V]

NC	Number Concepts	**RF**	Relations and Functions	**TR**	Transformations
NO	Number Operations	**M**	Measurement	**DA**	Data Analysis
P	Patterns	**3D**	3-D Objects and 2-D Shapes	**CU**	Chance and Uncertainty
VE	Variables and Equations				

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Topic 2: Quadratic Functions and Equations

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.	(RF) 2.1 Determine the following characteristics of the graph of a quadratic function: • vertex • domain and range • axis of symmetry • intercepts. [C, PS, T, V] (RF) 2.2 Connect algebraic and graphical transformations of quadratic functions, using completing the square as required. [CN, T, V] (RF) 2.3 Model real-world situations, using quadratic functions. [CN, PS] (RF) 2.4 Solve quadratic equations, and relate the solutions to the zeros of a corresponding quadratic function, using: • factoring • the quadratic formula • graphing. [CN, E, T, V] (RF) 2.5 Determine the character of the real and non-real roots of a quadratic equation, using: • the discriminant in the quadratic formula • graphing. [C, R, T, V]

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Topic 3: Polynomial and Other Nonlinear Equations and Functions

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Represent and analyze situations that involve expressions, equations and inequalities.	(VE) 3.1 Solve nonlinear equations: • by factoring • graphically. [CN, T, V]
	(VE) 3.2 Use the remainder theorem to evaluate polynomial expressions and the factor theorem to determine factors of polynomials. [E, PS, T]
Examine the nature of relations with an emphasis on functions.	(RF) 3.3 Perform operations on functions and compositions of functions. [CN, E, PS]
	(RF) 3.4 Determine the inverse of a function. [CN, R, V]
Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.	(RF) 3.5 Describe, graph and analyze polynomial and rational functions, using technology. [C, R, T, V]
	(RF) 3.6 Formulate and apply strategies to solve: • absolute value equations • radical equations • rational equations • quadratic inequalities • polynomial inequalities. [CN, R, T, V]

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Topic 4: Formal Reasoning

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Apply the principles of mathematical reasoning to solve problems and to justify solutions.	(P) 4.1 Differentiate between inductive and deductive reasoning. [CN, R] (P) 4.2 Explain and apply connecting words, such as "and", "or" and "not", to solve problems. [C, PS, R, V] (P) 4.3 Use examples and counterexamples to analyze conjectures. [CN, R] (P) 4.4 Distinguish between an "if–then" proposition, its converse and its contrapositive. [CN, R] (P) 4.5 Prove assertions in a variety of settings, using direct reasoning. [R]

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Topic 5: Circles and Coordinate Geometry

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Develop and apply the geometric properties of circles and polygons to solve problems.	(3D) 5.1 Use technology and measurement to confirm and apply the following properties to particular cases: • the perpendicular from the centre of a circle to a chord bisects the chord • the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc • the inscribed angles subtended by the same arc are congruent • the angle inscribed in a semicircle is a right angle • the opposite angles of a cyclic quadrilateral are supplementary • a tangent to a circle is perpendicular to the radius at the point of tangency • the tangent segments to a circle, from any external point, are congruent • the angle between a tangent and a chord is equal to the inscribed angle on the opposite side of the chord • the sum of the interior angles of an n-sided polygon is $(2n - 4)$ right angles. [PS, R, T, V] (3D) 5.2 Prove the following general properties, using established concepts and theorems: • the perpendicular bisector of a chord contains the centre of the circle • the angle inscribed in a semicircle is a right angle • the tangent segments to a circle from any external point are congruent. [PS, R, CN] (3D) 5.3 Solve problems, using a variety of circle properties and relevant trigonometric ratios, and justify the solution strategy used. [PS, R, V]

(continued)

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Topic 5: Circles and Coordinate Geometry
(continued)

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve coordinate geometry problems involving lines and line segments, and justify the solutions.	(3D) 5.4 Solve problems involving distances between points and lines. [CN, PS, R] (3D) 5.5 Verify and prove assertions in plane geometry, using coordinate geometry and trigonometric ratios as necessary. [C, R, V]

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Topic 6: Finance

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve consumer problems, using arithmetic operations.	(NO) 6.1 Solve consumer problems, which may include examples such as: • wages earned in various situations • property taxation • exchange rates. [CN, E, PS, R, T] (NO) 6.2 Reconcile financial statements, which may include: • cheque books and bank statements • credit card statements • loan statements. [CN, PS, T] (NO) 6.3 Solve budget problems, using graphs and tables to communicate solutions. [C, PS, T, V] (NO) 6.4 Plot and describe financial data of exponential form. [C, T, V] (NO) 6.5 Solve investment and credit problems involving simple and compound interest. [CN, PS, T]

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Topic 1: Transformations of Functions

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Perform, analyze and create transformations of functions and relations that are described by equations or graphs.	(TR) 1.1 Describe how various translations of functions affect graphs and their related equations: • $y = f(x - h)$ • $y - k = f(x)$. [C, T, V]
	(TR) 1.2 Describe how various stretches of functions (compressions and expansions) affect graphs and their related equations: • $y = af(x)$ • $y = f(kx)$. [C, T, V]
	(TR) 1.3 Describe how reflections of functions in both axes and in the line $y = x$ affect graphs and their related equations: • $y = f(-x)$ • $y = -f(x)$ • $y = f^{-1}(x)$. [C, T, V]
	(TR) 1.4 Using the graph and/or the equation of $f(x)$, describe and sketch $\frac{1}{f(x)}$. [C, T, V]
	(TR) 1.5 Describe and perform single transformations and combinations of transformations on functions and relations. [C, T, V]

NC	Number Concepts	**RF**	Relations and Functions	**TR**	Transformations
NO	Number Operations	**M**	Measurement	**DA**	Data Analysis
P	Patterns	**3D**	3-D Objects and 2-D Shapes	**CU**	Chance and Uncertainty
VE	Variables and Equations				

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Topic 2: Exponents, Logarithms and Geometric Series

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Generate and analyze exponential patterns.	(P) 2.1 Derive and apply expressions to represent general terms and sums for geometric growth and to solve problems. [CN, R, T]
	(P) 2.2 Connect geometric sequences to exponential functions over the natural numbers. [E, R, V]
Solve exponential, logarithmic and trigonometric equations and identities.	(VE) 2.3 Solve exponential equations having bases that are powers of one another. [E, R]
	(VE) 2.4 Use the laws of exponents and logarithms to: • solve and verify exponential equations and identities • solve logarithmic equations • simplify logarithmic expressions. [R]

(continued)

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Topic 2: Exponents, Logarithms and Geometric Series (continued)

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Represent and analyze exponential and logarithmic functions, using technology as appropriate.	(RF) 2.5 Graph and analyze an exponential function, using technology. [R, T, V]
	(RF) 2.6 Model, graph and apply exponential functions to solve problems. [PS, T, V]
	(RF) 2.7 Change functions from exponential form to logarithmic form and vice versa. [CN]
	(RF) 2.8 Use logarithms to model practical problems. [CN, PS, V]
	(RF) 2.9 Explain the relationship between the laws of logarithms and the laws of exponents. [C, T]
	(RF) 2.10 Graph and analyze logarithmic functions with and without technology. [R, T, V]

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Topic 3: Trigonometry

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve exponential, logarithmic and trigonometric equations and identities.	(VE) 3.1 Distinguish between degree and radian measure, and solve problems using both. [CN, E]
	(VE) 3.2 Determine the exact and the approximate values of trigonometric ratios for any multiples of 0°, 30°, 45°, 60° and 90° and 0, $\frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}$. [CN, E]
	(VE) 3.3 Solve first and second degree trigonometric equations over the domain $0 \leq \vartheta < 2\pi$ or the domain $0^\circ \leq \vartheta < 360^\circ$ • algebraically • graphically. [PS, T]
	(VE) 3.4 Determine the general solutions to trigonometric equations where the domain is the set of real numbers. [PS, T]
	(VE) 3.5 Verify trigonometric identities: • numerically for any particular case • algebraically for general cases • graphically. [PS, R, T, V]

(continued)

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Topic 3: Trigonometry (continued)

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Represent and analyze trigonometric functions, using technology as appropriate.	(RF) 3.6 Describe sine, cosine and tangent as circular functions, with reference to the unit circle and an angle in standard position. [PS, R, V] (RF) 3.7 Use sum, difference and double angle identities for sine and cosine to verify and simplify trigonometric expressions. [R, T] (RF) 3.8 Draw (using technology), sketch and analyze the graphs of sine, cosine and tangent functions, for: • amplitude, if defined • period • domain and range • asymptotes, if any • behaviour under transformations. [CN, T, V] (RF) 3.9 Draw and sketch (using technology) and analyze the graphs of secant, cosecant and cotangent functions, for: • period • domain and range • asymptotes • behaviour under horizontal and vertical stretches. [CN, T, V] (RF) 3.10 Use sine and cosine functions to model and solve problems. [PS, R, V]

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Topic 4: Conic Sections

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Classify conic sections, using their shapes and equations.	(3D) 4.1 Classify conic sections according to shape. [C, R, V]
	(3D) 4.2 Classify conic sections according to a given equation in general or standard (completed square) form (vertical or horizontal axis of symmetry only). [CN, T, V]
	(3D) 4.3 Convert a given equation of a conic section from general to standard form and vice versa. [R, T]

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Topic 5: Permutations and Combinations

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations.	(CU) 5.1 Use the fundamental counting principle to determine the number of different ways to perform multistep operations. [PS, R]
	(CU) 5.2 Determine the number of linear permutations of n objects taken r at a time, and use this to solve problems. [PS, R, V]
	(CU) 5.3 Determine the number of combinations of n distinguishable objects taken r at a time, and use this to solve problems. [PS, R, V]
	(CU) 5.4 Determine the number of pathways in a given simple pathway problem. [CN, PS, R, V]
	(CU) 5.5 Determine the number of pathways in a given compound pathway problem. [CN, PS, R, V]
	(CU) 5.6 Solve problems using the binomial theorem, where the exponent n belongs to the set of natural numbers. [CN, E, PS, V]
Model the probability of a compound event, and solve problems based on the combining of simpler probabilities.	(CU) 5.7 Solve probability problems using either permutations and combinations or the fundamental counting principle. [E, PS, R]

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Topic 6: Statistics

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Use normal and binomial probability distributions to solve problems involving uncertainty.	(CU) 6.1 Find the population standard deviation of a data set, using technology. [CN, E, T, V] (CU) 6.2 Solve probability problems, using the binomial distribution. [PS, R, T] (CU) 6.3 Use z-scores to solve problems related to the normal distribution. [PS, R, T, V]

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MATHEMATICS 31

A. COURSE OVERVIEW

RATIONALE

To set goals and make informed choices, students need an array of thinking and problem-solving skills. Fundamental to this is an understanding of mathematical techniques and processes that will enable them to apply the basic skills necessary to address everyday mathematical situations, as well as acquire higher order skills in logical analyses and methods for making valid inferences.

A knowledge of mathematics is essential to a well-educated citizenry. However, the need for and use of mathematics in the life of the average citizen are changing. **Emphasis has shifted from the memorization of mathematical formulas and algorithms toward a dynamic view of mathematics as a precise language of terms and symbolic notation, used to describe, reason, interpret and explore.** There is still a need for the logical development of concepts and skills as a basis for the appropriate use of mathematical information to solve problems. Problem-solving strategies, combined with techniques such as estimation and simulation, and incorporated with modern technology, are the tools with which mathematical problems are solved.

Students need procedural competence with numbers and operations, together with a facility in basic algebraic operations and an understanding of fundamental mathematical concepts. They also need to understand the connections among related concepts and be familiar with their use in relevant applications. Students must be able to solve problems, using the mathematical processes developed, and be confident in their ability to apply known mathematical skills and concepts in the acquisition of new mathematical knowledge. In addition, the ability of technology to provide quick and accurate computation and manipulation, to enhance conceptual understanding and to facilitate higher order thinking, should be recognized and used by students.

Mathematics programs must anticipate the changing needs of society, and provide students with the mathematical concepts, skills and attitudes necessary to cope with the challenges of the future.

The majority of students who are enrolled in senior high school mathematics have not yet completely internalized formal thinking with regard to mathematics. They are expected to acquire much abstract understanding in senior high school mathematics courses. The content of each course in the mathematics program is designed to be cognitively appropriate and presented in a way that is consistent with the students' abilities to understand.

The senior high school mathematics program includes the course sequences:

- Mathematics 10–20–30 and Mathematics 31
- Mathematics 13–23–33
- Mathematics 14–24
- Mathematics 16–26.

Mathematics 31 is generally taken after Mathematics 30; however, Mathematics 31 and Mathematics 30 may be taken concurrently.

Mathematics 10–20–30 and Mathematics 31 are designed for students who have achieved the acceptable standard in Mathematics 9, and who are intending to pursue studies beyond high school at a university or in a mathematics-intensive program at a technical school or college. Mathematics 10–20–30 emphasizes the theoretical development of topics in algebra, geometry, trigonometry and statistics up to a level acceptable for entry into such programs.

Having successfully achieved the acceptable standard in each of Mathematics 10, Mathematics 20 and Mathematics 30, students will have met or exceeded the basic mathematics entry requirements for most university or university transfer programs, and will have met or exceeded all mathematics entry requirements for technical school or college programs. A significant number of students would benefit by taking a course in calculus, thus improving their opportunity for success in higher level courses in mathematics at university, such as those required by mathematics and physics honours programs, or by engineering and business programs.

Mathematics 31 emphasizes the theoretical and practical development of topics in the algebra of functions, trigonometry, differential calculus and integral calculus up to a standard acceptable for entry into all first-year programs in mathematics, science, engineering and business. The course is designed to bridge the gap between the Mathematics 10–20–30 course sequence and the calculus course sequences offered by post-secondary institutions.

GOALS

As a culmination of the Mathematics 10–20–30 and Mathematics 31 course sequence, the **specific purposes** of the Mathematics 31 course of studies are as follows:

- to develop an understanding of the algebra of functions and transformations, together with their graphs, and to apply these understandings in different areas of mathematics
- to develop a fluency in algebraic computations involving rational expressions, inequalities, absolute values and trigonometric functions
- to introduce the principal concepts and methods of differential and integral calculus
- to develop skills in problem solving and reasoning, using calculus concepts and procedures as the context
- to apply the methods of calculus to various simple applications in the physical and biological sciences, in engineering, in business and in the social sciences.

PHILOSOPHY

Following the principles elaborated in the *Curriculum and Evaluation Standards for School Mathematics*, National Council of Teachers of Mathematics, 1989, the major focuses of the Mathematics 31 course of studies are on **attitudes**, **problem solving**, **communication**, **reasoning**, **connections** and **technology**. In this document, the term **mathematical processes** is used to make reference to these focuses. Further elaborations of these focuses are given below.

Attitudes

Students are expected to develop an appreciation for the beauty and power of mathematics as a method of solving problems and as an expression of human thought. From this appreciation, they should respect evidence and data, show open-mindedness toward the points of view of others, endeavour to be creative in thinking, persevere in the face of difficulties, be curious in their view of the world, and show a desire to understand. They should show respect for and appreciation of the roles of science and technology in the learning and doing of mathematics.

Problem Solving

Students develop a deep understanding of mathematical concepts and procedures when they solve problems related to practical contexts, to contexts within mathematics itself, and to other school subjects. Students are expected to decide on which concepts and procedures are likely to be useful in solving a particular problem, plan the appropriate application of concepts and procedures to the situation, carry out the plan, and evaluate the reasonableness of the solution and solution procedure when the task is complete. They should then be expected to modify the solution procedure to solve a closely related problem, or apply the solution procedure to a new situation.

Communication

As well as being expected to construct solutions to problems, students are expected to communicate both solutions and solution procedures. They are expected to communicate the representations used for concepts, any approximations or limitations that are inherent in the solution, the reliability of the final solution, and the reasons why particular methods were used. These communications may be oral or written. Students should be able to use the language and symbolism of mathematics appropriately.

Reasoning

A major part of mathematics is reasoning. Students are expected to analyze situations, make assumptions, make and test conjectures, draw conclusions and justify solution procedures. The level of reasoning may vary from speculative to formally rigorous, and students are expected to be able to reason at all of these levels, depending on the context and the purpose set in the problem.

Connections

Students are expected to make connections among mathematics concepts, between mathematics and other school subjects, and between mathematics and everyday life. They are required especially to link new learning to the mathematics they already know, and to apply both old and new mathematics to a wide variety of problem situations. They are expected to make connections between algebraic and geometric representations, and between numerical and symbolic methods. In addition, they are expected to be able to communicate and justify the connections made in a problem solution.

Technology

Students are expected to be aware of the capabilities of various technologies, such as scientific calculators, including those with graphing capabilities; graphing computer software and productivity software, such as word processing, spreadsheet, database and symbol manipulation programs. From this awareness, students are expected to use technology appropriate to the task at hand. Besides the use of technology for precise solutions, students are expected to provide estimates, approximations and sketches, using pencil and paper methods, with no technological aids.

EXPECTATIONS

Students are expected to be mathematically literate at the conclusion of their senior high school mathematics education. **Mathematical literacy** refers to students' abilities and inclinations to manage the demands of their world through the use of mathematical concepts and procedures to solve problems, communicate and reason. More specifically, *students will be expected to:*

- have developed the concepts, skills and attitudes that will enable the acquisition of mathematical knowledge beyond the conclusion of secondary education
- have developed the concepts, skills and attitudes that will ensure success in mathematical situations that occur in future educational endeavours, employment and everyday life
- have achieved understanding of the basic mathematical concepts, and developed the skills and attitudes needed to become responsible and contributing members of society

- apply basic mathematical concepts and skills in practical situations
- have developed critical and creative thinking skills
- communicate mathematical ideas effectively
- understand how mathematics can be used to investigate, interpret and make decisions in human affairs
- understand how mathematics can be used in the analyses of natural phenomena
- understand the connections and interplay among various mathematical concepts and between mathematics and other disciplines
- understand and appreciate the positive contributions of mathematics, as a science and as an art, to civilization and culture.

B. LEARNER EXPECTATIONS

COURSE FOCUS

The Mathematics 31 course is designed to introduce students to the mathematical methods of calculus. The course acts as a link between the outcomes of the Mathematics 10–20–30 program and the requirements of the mathematics encountered in post-secondary programs. The course builds on existing skills in working with functions and expands this knowledge to include a study of limits in preparation for a study of differential and integral calculus. The methods of calculus are applied to problems encountered in the areas of science, engineering, business and other fields of endeavour.

The focus of the course is to examine functions that describe changing situations as opposed to the more static situations encountered in previous mathematics courses. Emphasis is placed on using graphical methods to illustrate the way in which changing functions behave.

COURSE STRUCTURE

Mathematics 31 is designed in a required–elective format. The **required component** is intended to take the larger proportion of the instructional time. There are eight units available in the **elective component**, of which one or more units are intended to take the remainder of the instructional time.

The time given to the required component, and the number of elective units covered, will vary, depending on local needs. In general, most students will do one or two elective units; however, some students must do as many as four in order to integrate the requirements of external agencies into the Mathematics 31 course.

Required Component

The four sections of the required component are as follows:

- precalculus and limits
- derivatives and derivative theorems
- applications of derivatives
- integrals, integral theorems and integral applications.

Elective Component

The eight possible units available in the elective component are as follows:

- calculus of exponential and logarithmic functions
- numerical methods
- volumes of revolution
- applications of calculus to physical sciences and engineering
- applications of calculus to biological sciences
- applications of calculus to business and economics
- calculus theorems
- further methods of integration.

COURSE LEARNER EXPECTATIONS

The learner expectations found on pages 8 through 51 are the required student outcomes at the end of the Mathematics 31 course. **They do not serve as a required sequence for instruction.** The sequence for instruction will vary, depending on the mathematical background of the students, the learning resources being used, and the preferences of individual teachers.

The learner expectations are divided into *course general learner expectations* and *related specific learner expectations*.

The *course general learner expectations* for Mathematics 31, on pages 8 and 9, provide a bridge between the philosophy statements for all senior high school mathematics courses and the *related specific learner expectations* for each section or unit of study.

The *related specific learner expectations* refer to particular areas of study, such as limits and antiderivatives. They are on pages 10 through 35 for the **required component**, and on pages 36 through 51 for the **elective component**.

Learner expectations are organized into five concept strands, each with three outcome columns. The strands are identified as Mathematical Processes, Measurement and Geometry, Algebra of Functions and Limits, Calculus of Derivatives and Integrals, and Data

Management. The outcomes are organized under Conceptual Understanding, Procedural Knowledge and Problem-solving Contexts.

Although itemized separately, the outcomes are meant to be developed together, using an appropriate balance for the content being studied, and applying the learnings in an appropriate context.

Strands

The strand, **Mathematical Processes**, describes problem-solving, communication and reasoning strategies that apply to many areas of mathematics. Examples include the construction and use of mathematical models and the proper use of approximation techniques for difficult calculations.

In the context of the Mathematics 31 course, mathematical processes include the making and testing of conjectures, the comparison of numerical and algebraic solutions, the connections between similar solution procedures and completely different problems, and the differences between intuitive and rigorous proofs.

The strand, **Measurement and Geometry**, describes the mathematics of spatial reasoning. Measurement involves associating numerical values to various geometrical properties of one-, two- or three-dimensional figures while the geometry involves the properties of one-, two- or three-dimensional figures, and the geometrical representation of domains, limits, derivatives and integrals.

In the context of the Mathematics 31 course, measurement and geometry involve the generalizations of the concepts of slope, curve, line and average to contexts characterized by change, and to contexts where the traditional descriptions give misleading interpretations.

The strand, **Algebra of Functions and Limits**, describes the generalization of patterns, and its description in ordered pair, symbolic and geometrical forms.

In the context of the Mathematics 31 course, the algebra of functions and limits represents an extension of algebraic concepts to enable algebraic models to be used in contexts where functions may not exist, or may be discontinuous.

The strand, **Calculus of Derivatives and Integrals**, describes the extension of algebra to situations that model change.

In the context of the Mathematics 31 course, the calculus of derivatives and integrals refers only to the differential and integral calculus of relations and functions of a single, real variable. The emphasis is more on the use and application of derivatives, and less on the use and application of integrals.

The strand, **Data Management**, describes the mathematics of information processing, from the description of simple data sets to the making of predictions based on models constructed from the data.

In the context of the Mathematics 31 course, data management is confined to the generalization of the concepts of average value and equation root, together with the development of tools that can compute numerical approximations to any desired degree of accuracy. The calculus of random variables is not part of Mathematics 31, though the calculus methods developed in Mathematics 31 could be used in the context of a random variable and its associated probability distribution.

Outcomes

The **Conceptual Understanding** outcomes refer to the major concepts involved in the development of understanding the algebra of functions, the establishment of limits, the differential calculus and the integral calculus.

Conceptual expectations are characterized by the use of such action verbs as *defining, demonstrating, describing, developing, establishing, explaining, giving, identifying, illustrating, linking, recognizing and representing.*

The **Procedural Knowledge** outcomes refer to the development of fluency in carrying out procedures related to the general learner expectations. Examples of such procedures are those used for the computation of limits, derivatives and integrals, the determination of maxima and minima, and the computation of average values of functions over intervals.

Procedural expectations are characterized by the use of such action verbs as *approximating, calculating, constructing, differentiating, estimating, factoring, locating, rationalizing, simplifying, sketching, solving, using* and *verifying*.

The Problem-solving Contexts outcomes refer to the construction of models describing applications in a broad range of contexts. They also refer to the combination of algorithms to determine more complicated combinations of limits, derivatives and integrals, and to the use of appropriate technology to approximate difficult models or to carry out long, computational procedures. They also refer to the investigation of phenomena, the collection and interpretation of data in various contexts, and the transfer of knowledge from mathematics to other areas of human endeavour.

Problem-solving expectations are characterized by the use of such action verbs as *adapting, analyzing, combining, communicating, comparing, connecting, constructing, deriving, evaluating, fitting, investigating, justifying, modelling, proving, reconstructing* and *translating*.

COURSE GENERAL LEARNER EXPECTATIONS BY STRAND

STRANDS	CONCEPTUAL UNDERSTANDING
	Students will demonstrate understanding of the concepts of Mathematics 31, by:
Mathematical Processes Mastery of *course* expectations enables students to construct and solve models describing mathematical situations in a broad range of contexts, and to use the appropriate technology to approximate difficult models and carry out long calculations.	• identifying and giving examples of the strengths and limitations of the use of technology in the computation of limits, derivatives and integrals • giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals.
Measurement and Geometry Mastery of *course* expectations enables students to demonstrate the conceptual underpinnings of calculus to determine limits, derivatives, integrals, rates of change and averages, using geometrical representations.	• describing the relationships among functions after performing translations, reflections, stretches and compositions on a variety of functions • linking displacement, velocity and acceleration of an object moving in a straight line with nonuniform velocity.
Algebra of Functions and Limits Mastery of *course* expectations enables students to translate among symbolic, diagram and graphical representations of situations that describe both continuous and discrete functions of one real variable.	• giving examples of the limits of functions and sequences, both at finite and infinite values of the independent variable.
Calculus of Derivatives and Integrals Mastery of *course* expectations enables students to determine limits, derivatives, integrals and rates of change.	• connecting the derivative with a particular limit, and expressing this limit in situations like secant and tangent lines to a curve • relating the derivative of a complicated function to the derivative of simpler functions • relating the zeros of the derivative function to the critical points on the original curve • recognizing that integration can be thought of as an inverse operation to that of finding derivatives.
Data Management Mastery of *course* expectations enables students to use calculus concepts to describe data distributions and random variables at an introductory level.	• describing the connections between the operation of integration and the finding of areas and averages.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures of Mathematics 31, by:	*Students will* demonstrate problem-solving skills in Mathematics 31, by:
• combining and modifying familiar solution procedures to form a new solution procedure to a related problem.	• using the connections between a given problem and either a simpler or equivalent problem, or a previously solved problem, to solve the given problem • producing approximate answers to complex calculations by simplifying the models used.
• drawing the graphs of functions by applying transformations to the graphs of known functions • calculating the displacement, velocity and acceleration of an object moving in a straight line with nonuniform velocity.	• constructing geometrical proofs at an intuitive level that generalize the concepts of slope, area, average and rate of change.
• expressing final algebraic and trigonometric answers in a variety of equivalent forms, with the form chosen to be the most suitable form for the task at hand • computing limits of functions, using definitions, limit theorems and calculator/computer methods.	• constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable.
• computing derivatives of functions, using definitions, derivative theorems and calculator/computer methods • computing definite and indefinite integrals of simple functions, using antiderivatives, integral theorems and calculator/computer methods.	• determining the optimum values of a variable in various contexts, using the concepts of maximum and minimum values of a function • using the concept of critical values to sketch the graphs of functions, and comparing these sketches to computer-generated plots of the same functions • connecting a derivative and the appropriate rate of change, and using this connection to relate complicated rates of change to simpler ones.
• calculating the mean value of a function over an interval.	• fitting mathematical models to situations described by data sets.

RELATED SPECIFIC LEARNER EXPECTATIONS FOR REQUIRED COMPONENT

PRECALCULUS AND LIMITS (Required)

Overview

The first parts of this Mathematics 31 section are designed to reinforce and extend algebraic and trigonometric skills. The algebra of functions introduced in Mathematics 20 and applied to exponential, logarithmic, trigonometric and polynomial functions in Mathematics 30 is extended to the general function. Algebraic and geometric representations of transformations are used. The skills acquired are a necessary adjunct to all work in the Mathematics 31 course. The last part concentrates on the numerical and geometrical development of the concepts of limits and limit theorems.

Student Outcomes Summary

After completing this section, students will be expected to have acquired reliability and fluency in the algebraic skills of factoring, operations with radicals and radical expressions, coordinate geometry, and transformation of functions. They will also be expected to solve linear, quadratic and absolute value inequalities, and to solve trigonometric equations and identities. They will be expected to express the concept of a limit numerically and geometrically, and to calculate limits, using first principles and the limit theorems.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that functions, as well as variables, can be combined, using operations, such as addition and multiplication, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the algebra of functions, by:
• describing the relationship among functions after performing translations, reflections, stretches and compositions on a variety of functions	• illustrating different notations that describe functions and intervals
• drawing the graphs of functions by applying transformations to the graphs of known functions	• expressing, in interval notation, the domain and range of functions
• expressing final algebraic and trigonometric answers in a variety of equivalent forms, with the form chosen to be the most suitable form for the task at hand	• expressing the sum, product, difference and quotient, algebraically and graphically, given any two functions
• constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable.	• expressing, algebraically and graphically, the composition of two or more functions
	• illustrating the solution sets for linear, quadratic and absolute value inequalities $\lvert P(x)\rvert \geq a$ $\lvert P(x)\rvert \leq a$ $ax^2+bx+c \geq d$
	• illustrating the difference between the concepts of equation and identity in trigonometric contexts.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the algebra of functions, by:	*Students will* demonstrate problem-solving skills, by:
• using open, closed and semi-open interval notation	• modelling problem situations, using sums, differences, products and quotients of functions
• finding the sum, difference, product, quotient and composition of functions	• investigating the connections between the algebraic form of a function $f(x)$ and the symmetries of its graph.
• solving inequalities of the types $\lvert P(x)\rvert \geq a$ $\quad \left\lvert \frac{P(x)}{Q(x)} \right\rvert \geq a$ $\lvert P(x)\rvert \leq a$ $\frac{P(x)}{Q(x)} \geq a$ $\quad ax^2+bx+c \geq d$	
• using the following trigonometric identities: • primary and reciprocal ratio • double and half angle • sum and difference $\sin(A \pm B)$ $\cos(A \pm B)$ • Pythagorean to simplify expressions and solve equations, express sums and differences as products, and rewrite expressions in a variety of equivalent forms.	

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that functions can be transformed, and these transformations can be represented algebraically and geometrically, and demonstrate this, by: • describing the relationship among functions after performing translations, reflections, stretches and compositions on a variety of functions • drawing the graphs of functions by applying transformations to the graphs of known functions • expressing final algebraic and trigonometric answers in a variety of equivalent forms, with the form chosen to be the most suitable form for the task at hand • constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable.	*Students will* demonstrate conceptual understanding of the transformation of functions, by: • describing the similarities and differences between the graphs of $y=f(x)$ and $y=af[k(x+c)]+d$, where a, k, c and d are real numbers • describing the effects of the reflection of the graphs of algebraic and trigonometric functions across any of the lines $y=x$, $y=0$, or $x=0$ • describing the effects of the parameters a, b, c and d on the trigonometric function $f(x)=a\sin[b(x+c)]+d$ --- • describing the relationship between parallel and perpendicular lines • describing the condition for tangent, normal and secant lines to a curve • linking two problem conditions to a system of two equations for two unknowns.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the transformation of functions, by:	*Students will* demonstrate problem-solving skills, by:

• sketching the graph of, and describing algebraically, the effects of any translation, reflection or dilatation on any of the following functions or their inverses:
  • linear, quadratic or cubic polynomial
  • absolute value
  • reciprocal
  • exponential
  • step
• sketching and describing, algebraically, the effects of any combination of translation, reflection or dilatation on the following functions:
  • $f(x)=a\sin[b(x+c)]+d$
  • $f(x)=a\cos[b(x+c)]+d$
  • $f(x)=a\tan[b(x+c)]$
	• translating problem conditions into equation or inequality form.

• finding the equation of a line, given any two conditions that serve to define it • solving systems of linear–linear, linear–quadratic or quadratic–quadratic equations.	

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that final answers may be expressed in different equivalent forms, and demonstrate this, by: • giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals • expressing final algebraic and trigonometric answers in a variety of equivalent forms, with the form chosen to be the most suitable form for the task at hand.	*Students will* demonstrate conceptual understanding of equivalent forms, by: • describing what it means for two algebraic or trigonometric expressions to be equivalent.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the construction of equivalent forms, by: • factoring expressions with integral and rational exponents, using a variety of techniques • rationalizing expressions containing a numerator or a denominator that contains a radical • simplifying rational expressions, using any of the four basic operations.	*Students will* demonstrate problem-solving skills, by: • illustrating the difference between verification and proof in the comparison of two algebraic or trigonometric expressions.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that descriptions of change require a careful definition of limit and the precise use of limit theorems, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of limits and limit theorems, by:
• identifying and giving examples of the strengths and limitations of the use of technology in the computation of limits, derivatives and integrals	• explaining the concept of a limit
• giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals	• giving examples of functions with limits, with left-hand or right-hand limits, or with no limit
• giving examples of the limits of functions and sequences, both at finite and infinite values of the independent variable	• giving examples of bounded and unbounded functions, and of bounded functions with no limit
• computing limits of functions, using definitions, limit theorems and calculator/ computer methods.	• explaining, and giving examples of, continuous and discontinuous functions
	• defining the limit of an infinite sequence and an infinite series
	• explaining the limit theorems for sum, difference, multiple, product, quotient and power
	• illustrating, using suitable examples, the limit theorems for sum, difference, multiple, product, quotient and power.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with limits and limit theorems, by:	*Students will* demonstrate problem-solving skills, by:
• determining the limit of any algebraic function as the independent variable approaches finite or infinite values for continuous and discontinuous functions • sketching continuous and discontinuous functions, using limits, intercepts and symmetry	• proving and illustrating geometrically, the following trigonometric limits: $\lim_{x\to 0} \frac{\sin x}{x}$ or $\lim_{x\to 0} \frac{x}{\sin x} = 1$ AND $\lim_{x\to 0} \frac{\cos x - 1}{x} = 0$
• calculating the sum of an infinite convergent geometric series	• using the basic trigonometric limits, combined with limit theorems, to determine the limits of more complex trigonometric expressions
• using definitions and limit theorems to determine the limit of any algebraic function as the independent variable approaches a fixed value • using definitions and limit theorems to determine the limit of any algebraic function as the independent variable approaches $\pm\infty$.	• comparing numerical and algebraic processes for the determination of algebraic and trigonometric limits.

DERIVATIVES AND DERIVATIVE THEOREMS (Required)

Overview

The concept of the slope of a line can be extended to give students an intuitive feel for the meaning of slope at a point on a curve. By examining slopes of secants, and using the ideas of limits, the derivative can be put into a well-defined form. Derivative theorems are used to find only the derivatives of algebraic and trigonometric functions.

Student Outcomes Summary

After completing this section, students will be expected to find derivatives of algebraic and trigonometric functions and determine equations of tangents at specific points. For selected functions, they will also be expected to prove these derivatives, using first principles. Students use the power, chain, product and quotient rules to calculate the derivatives of these functions. They will also be expected to use implicit differentiation to find the derivatives of certain algebraic and trigonometric relations.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that the derivative of a function is a limit that can be found, using first principles, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of derivatives, by:
• giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals	• showing that the slope of a tangent line is a limit
• connecting the derivative with a particular limit, and expressing this limit in situations like secant and tangent lines to a curve	• explaining how the derivative of a polynomial function can be approximated, using a sequence of secant lines
• computing derivatives of functions, using definitions, derivative theorems and calculator/computer methods.	• explaining how the derivative is connected to the slope of the tangent line
	• recognizing that $f(x)=x^n$ can be differentiated where $n \in R$
	• identifying the notations $f'(x)$, y', and $\frac{dy}{dx}$ as alternative notations for the first derivative of a function
	• explaining the derivative theorems for sum and difference $(f \pm g)'(x)=f'(x) \pm g'(x)$
	• explaining the sense of the derivative theorems for sum and difference, using practical examples.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with derivatives, by:	*Students will* demonstrate problem-solving skills, by:
• finding the slopes and equations of tangent lines at given points on a curve, using the definition of the derivative	• deriving $f'(x)$ for polynomial functions up to the third degree, using the definition of the derivative
• estimating the numerical value of the derivative of a polynomial function at a point, using a sequence of secant lines	• using the definition of the derivative to find $f'(x)$ for $f(x)=(ax+c)^n$ where $n=-1$ or $n=\frac{1}{2}$.
• using the definition of the derivative to determine the derivative of $f(x)=x^n$ where n is a positive integer	
• differentiating polynomial functions, using the derivative theorems for sum and difference	
• differentiating functions that are single terms of the form x^n where n is rational.	

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that derivatives of more complicated functions can be found from the derivatives of simpler functions, using derivative theorems, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of derivative theorems, by:
• giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals	• demonstrating that the chain, power, product and quotient rules are aids to differentiate complicated functions
• relating the derivative of a complicated function to the derivative of simpler functions	• identifying implicit differentiation as a tool to differentiate functions where one variable is difficult to isolate
• expressing final algebraic and trigonometric answers in a variety of equivalent forms, with the form chosen to be the most suitable form for the task at hand	• explaining the relationship between implicit differentiation and the chain rule
• computing derivatives of functions, using definitions, derivative theorems and calculator/computer methods.	• comparing the sum, difference, product and quotient theorems for limits and derivatives
	• explaining the derivation of the derivative theorems for product and quotient $(fg)'(x) = f'(x)\,g(x) + f(x)\,g'(x)$ $\left(\frac{f}{g}\right)'(x) = \frac{f'(x)\,g(x) - f(x)\,g'(x)}{[g(x)]^2}$
	• explaining the derivative theorems for product and quotient, using practical examples
	• illustrating second, third and higher derivatives of algebraic functions
	• describing the second derivative geometrically.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with derivative theorems, by:	*Students will* demonstrate problem-solving skills, by:
• finding the derivative of a polynomial, power, product or quotient function • applying the chain rule in combination with the product and quotient rule • using the technique of implicit differentiation	• deriving the quotient rule from the product rule • showing that equivalent forms of the derivative of a rational function can be found by using the product and the quotient rules • determining the derivative of a function expressed as a product of more than two factors
• writing final answers in factored form • finding the slope and equations of tangent lines at given points on a curve	• determining the second derivative of an implicitly defined function AND, in one or more of the following, by: • showing the derivative for a relation found by both implicit and explicit differentiation to be the same • finding the equations of tangent lines to the standard conics.
• finding the second and third derivatives of functions.	

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that trigonometric functions have derivatives, and these derivatives obey the same derivative theorems as algebraic functions, and demonstrate this, by: • identifying and giving examples of the strengths and limitations of the use of technology in the computation of limits, derivatives and integrals • giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals • relating the derivative of a complicated function to the derivative of simpler functions • computing derivatives of functions, using definitions, derivative theorems and calculator/computer methods.	*Students will* demonstrate conceptual understanding of the derivatives of trigonometric functions, by: • demonstrating that the three primary trigonometric functions have derivatives at all points where the functions are defined • explaining how the derivative of a trigonometric function can be approximated, using a sequence of secant lines.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with derivatives of trigonometric functions, by:	*Students will* demonstrate problem-solving skills, by:
• calculating the derivatives of the three primary and three reciprocal trigonometric functions • estimating the numerical value of the derivative of a trigonometric function at a point, using a sequence of secant lines • using the power, chain, product and quotient rules to find the derivatives of more complicated trigonometric functions • using the derivative of a trigonometric function to calculate its slope at a point, and the equation of the tangent at that point.	• using the definition of the derivative to find the derivative for the sine and cosine functions • explaining why radian measure has to be used in the calculus of trigonometric functions.

APPLICATIONS OF DERIVATIVES (Required)

Overview

Inside the area of pure mathematics, graph sketching of polynomial functions, rational algebraic functions and simple trigonometric functions are looked at. Derivatives are used to solve maximum and minimum problems in economic and geometrical contexts and to solve related rate problems in geometrical and algebraic contexts.

Student Outcomes Summary

After completing this section, students will be expected to provide systematic sketches of graphs of polynomial, rational, algebraic and trigonometric functions of one variable. They will be expected to solve maximum–minimum and related rate problems in economic and geometric contexts. They will be expected to construct maximum–minimum and related rate models in geometric contexts, and to use the techniques of derivatives to solve problems based on the models constructed.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that calculus is a powerful tool in determining maximum and minimum points and in sketching of curves, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of maxima and minima, by:
• relating the zeros of the derivative function to the critical points on the original curve	• identifying, from a graph sketch, locations at which the first and second derivative are zero
• using the connections between a given problem and either a simpler or equivalent problem, or a previously solved problem, to solve the given problem	• illustrating under what conditions symmetry about the x-axis, y-axis or the origin will occur
• constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable	• explaining how the sign of the first derivative indicates whether or not a curve is rising or falling; and by explaining how the sign of the second derivative indicates the concavity of the graph
• determining the optimum values of a variable in various contexts, using the concepts of maximum and minimum values of a function	• illustrating, by examples, that a first derivative of zero is one possible condition for a maximum or a minimum to occur
• using the concept of critical values to sketch the graphs of functions, and comparing these sketches to computer-generated plots of the same functions	• explaining circumstances wherein maximum and minimum values occur when $f'(x)$ is not zero
• fitting mathematical models to situations described by data sets.	• illustrating, by examples, that a second derivative of zero is one possible condition for an inflection point to occur
	• explaining the differences between local maxima and minima and absolute maxima and minima in an interval
	• explaining when finding a maximum value is appropriate and when finding a minimum value is appropriate.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with maxima and minima, by:	*Students will* demonstrate problem-solving skills, by:
• sketching the graphs of the first and second derivative of a function, given its algebraic form or its graph • using zeros and intercepts to aid in graph sketching	• employing a systematic calculus procedure to sketch algebraic and trigonometric functions • comparing and contrasting graphs plotted on a calculator and graphs sketched, using a systematic calculus procedure • calculating maxima and minima for such quantities as volumes, areas, perimeters and costs • illustrating the connections among geometric, economic or motion problems, the modelling equations of these problems, the resulting critical points on the graphs and their solutions, using derivatives
• using the first and second derivatives to find maxima, minima and inflection points to aid in graph sketching • determining vertical, horizontal and oblique asymptotes, and domains and ranges of a function • finding intervals where the derivative is greater than zero or less than zero in order to predict where the function is increasing or decreasing • verifying whether or not a critical point is a maximum or a minimum	AND, in one or more of the following, by: • constructing a mathematical model to represent a geometric problem, and using the model to find maxima and/or minima • constructing a mathematical model to represent a problem in economics, and using the model to find maximum profits or minimum cost
• using a given model, in equation or graph form, to find maxima or minima that solve a problem.	• constructing a mathematical model to represent a motion problem, and using the model to find maximum or minimum time or distance.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that complicated rates of change can be related to simpler rates, using the chain rule, and demonstrate this, by: • relating the derivative of a complicated function to the derivative of simpler functions • combining and modifying familiar solution procedures to form a new solution procedure to a related problem • using the connections between a given problem and either a simpler or equivalent problem, or a previously solved problem, to solve the given problem • constructing geometrical proofs at an intuitive level that generalize the concepts of slope, area, average and rate of change • expressing the connection between a derivative and the appropriate rate of change, and using this connection to relate complicated rates of change to simpler ones.	*Students will* demonstrate conceptual understanding of related rates, by: • illustrating how the chain rule can be used to represent the relationship between two or more rates of change • explaining the clarity that Leibnitz's notation gives to expressing related rates • illustrating the time rate of change of a function $y=f(x)$ or a relation $R(x, y)=0$.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with related rates, by:	*Students will* demonstrate problem-solving skills, by:
• using the chain rule to find the derivative of a function with respect to an external variable, such as time • using Leibnitz's notation to illustrate related rates	• constructing a mathematical model to represent time rates of change of linear measures, areas, volumes, surface areas, etc. • solving related rate problems that use models containing primary trigonometric functions.
• constructing a chain rule of related rates, using appropriate variables • calculating related rates for the time derivatives of areas, volumes, surface areas and relative motion • calculating related rates of change with respect to time, given an equation that models electronic circuits or other engineering situations • using the chain rule to derive an acceleration function in terms of position, given a velocity function expressed in terms of position.	

INTEGRALS, INTEGRAL THEOREMS AND INTEGRAL APPLICATIONS (Required)

Overview

Corresponding to the operation of finding derivatives is the inverse operation of finding the antiderivatives. The area under a curve can be defined as the limit of the sum of small rectangular areas and can be found from this definition. The fundamental theorem of calculus links the solution of the area problem to the finding of special antiderivatives. As in the case of derivatives, the use of integral theorems makes the finding of antiderivatives and areas much easier. Derivatives and integrals can be interrelated through the context of nonuniform motion in a straight line.

Student Outcomes Summary

After completing this section, students will be expected to find the antiderivatives of any polynomial function, together with the antiderivatives of the simplest rational, algebraic and trigonometric functions. They will be expected to use antiderivatives to find areas under curves, and to use the connection between derivatives and integrals to relate displacement, velocity and acceleration. Conceptually, students will be expected to illustrate the properties of antiderivatives, definite integrals and the fundamental theorem of calculus, using geometric representations.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that the operation of finding a derivative has an inverse operation of finding an antiderivative, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of antiderivatives, by:
• giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals	• explaining how differentiation can have an inverse operation
• recognizing that integration can be thought of as an inverse operation to that of finding derivatives	• showing that many different functions can have the same derivative
• computing definite and indefinite integrals of simple functions, using antiderivatives, integral theorems and calculator/computer methods	• representing, on the same grid, a family of curves that form a sequence of functions, all having the same derivative.
• using the connections between a given problem and either a simpler or equivalent problem, or a previously solved problem, to solve the given problem.	

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with antiderivatives, by:	*Students will* demonstrate problem-solving skills, by:
• finding the antiderivatives of polynomials, rational algebraic functions and trigonometric functions	• finding the antiderivatives of rational functions and polynomial powers by comparison and inspection methods
• finding the family of curves whose first derivative has been given • solving separable first order differential equations for general and specific solutions.	• determining antiderivatives for polynomial, rational and trigonometric functions.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that the area under a curve can be expressed as the limit of a sum of smaller rectangles, and demonstrate this, by: • identifying and giving examples of the strengths and limitations of the use of technology in the computation of limits, derivatives and integrals • giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals • constructing geometrical proofs at an intuitive level that generalize the concepts of slope, area, average and rate of change.	*Students will* demonstrate conceptual understanding of area limits, by: • defining the area under a curve as a limit of the sums of the areas of rectangles • establishing the existence of upper and lower bounds for the area under a curve.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with area limits, by:	*Students will* demonstrate problem-solving skills, by:
• sketching the area under a curve (polynomials, rational, trigonometric) over a given interval, and approximating the area as the sum of individual rectangles.	• communicating the similarities and differences between definite integrals and areas under curves.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that the area under a curve can be related to the antiderivative of the function defining the curve; and in turn, can use the antiderivative to determine the areas under and between curves, and demonstrate this, by: • giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals • recognizing that integration can be thought of as an inverse operation to that of finding derivatives • describing the connections between the operation of integration with the finding of areas and averages • computing definite and indefinite integrals of simple functions, using antiderivatives, integral theorems and calculator/computer methods • calculating the mean value of a function over an interval • constructing geometrical proofs at an intuitive level that generalize the concepts of slope, area, average and rate of change.	*Students will* demonstrate conceptual understanding of definite integrals, by: • identifying the indefinite integral $\int f(x)dx$ as a sum of an antiderivative $F(x)$ and a constant c • explaining how the definite integral between fixed limits a and b is a number whose value is $F(b) - F(a)$ --- • explaining the connection between the numerical values of the area and the definite integral for functions f of a constant sign and a variable sign • illustrating the following properties of $\int_a^b cf(x)dx = c\int_a^b f(x)dx$ $\int_a^b [f(x) \pm g(x)]dx = \int_a^b f(x)dx \pm \int_a^b g(x)dx$ --- • describing the sense of the fundamental theorem of calculus • explaining how the fundamental theorem of calculus relates the area limit to the antiderivative of a function describing a curve.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with definite integrals, by:	*Students will* demonstrate problem-solving skills, by:
• calculating the definite integral for polynomial, rational and trigonometric functions	• relating the value of the integral between $x=a$ and $x=b$ to the area between the curve and the x-axis over the interval $[a, b]$ • using integration theorems, such as those listed below, to simplify definite integrals $\int_a^b f(x)dx = -\int_b^a f(x)dx$ $\int_a^c f(x)dx = \int_a^b f(x)dx + \int_b^c f(x)dx$ • using integral theorems to simplify more complicated integrals • illustrating the conditions necessary for a function to be differentiable, or able to be integrated.

• determining the area between a curve and the x-axis over a given domain
• determining the area between a curve and the x-axis:
  • if $f(x)$ has a constant sign over a given interval
  • if $f(x)$ has a change in sign over a given interval	

• determining the area between curves over a given interval • determining the area between intersecting curves.	

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that velocity and acceleration are the first and second derivatives of displacement with respect to time; and that once one of the three functions is known, the other two can be found by finding derivatives or antiderivatives, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the relationships among displacement, velocity and acceleration, by:
• linking displacement, velocity and acceleration of an object moving in a straight line with nonuniform velocity	• describing the motion of a body, using sketches of the first and second derivatives
• calculating the displacement, velocity and acceleration of an object moving in a straight line with nonuniform velocity	• explaining the difference between a stationary point and a turning point in the context of linear motion
• calculating the mean value of a function over an interval	• illustrating the concepts of derivative and antiderivative in the context of displacement, velocity and acceleration.
• constructing geometrical proofs at an intuitive level that generalize the concepts of slope, area, average and rate of change.	

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with displacement, velocity and acceleration, by:	*Students will* demonstrate problem-solving skills, by:
• estimating an instantaneous velocity, using slopes of secant lines to represent average velocities	• solving problems associated with distance, velocity and acceleration whose models are restricted to those of the forms $y'(t)=f(t)$ and $y''(t)=f(t)$

• finding the first and second derivatives of a position function to get instantaneous velocity and instantaneous acceleration functions, where the position function is an algebraic function or a trigonometric function of time
• using antiderivatives of acceleration and velocity functions to get velocity and displacement functions.
	• deriving the following kinematic equations, starting from the expression $a=$ constant:
	  • $v=at+v_0$
	  • $v^2=v_0{}^2+2ad$
	  • $d=\frac{1}{2}at^2+v_0 t+d_0$
	• determining the equations of velocity and acceleration in simple harmonic motion, starting from the displacement equation:
	  • $x=A\cos(kt+c)$.

RELATED SPECIFIC LEARNER EXPECTATIONS FOR ELECTIVE COMPONENT

CALCULUS OF EXPONENTIAL AND LOGARITHMIC FUNCTIONS (Elective)

Overview

The calculus of exponential and logarithmic functions has many important applications in modelling natural phenomena, such as natural growth and decay, and problems involving return to equilibrium, such as those found in thermal and chemical reactions. The study of natural logarithms and the natural base exponential function is key in the development of derivatives and integrals for all such functions, as well as in their applications. This elective, together with the elective Applications of Calculus to Biological Sciences, can be taught as an integrated whole.

Student Outcomes Summary

After completing this elective section, students will be expected to represent symbolically and graphically, differentiate and integrate, exponential and logarithmic functions. They will also be expected to solve problems where the modelling equation is given, and to construct equations to model a situation with given parameters.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that exponential and logarithmic functions have limits, derivatives and integrals that obey the same theorems as do algebraic and trigonometric functions, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the calculus of exponential and logarithmic functions, by:
• computing limits of functions, using definitions, limit theorems and calculator/computer methods	• defining exponential and logarithmic functions as inverse functions • explaining the special properties of the number *e*, together with a definition of *e* as a limit
• computing derivatives of functions, using definitions, derivative theorems and calculator/computer methods	• illustrating that the derivative of an exponential or logarithmic function may be derived from the definition of the derivative
• computing definite and indefinite integrals of simple functions, using antiderivatives, integral theorems and calculator/computer methods	
• constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable	• illustrating that base-*e* exponential and logarithmic functions form a convenient framework within which the calculus of similar functions in any base may be developed
• fitting mathematical models to situations described by data sets.	• illustrating how exponential and logarithmic functions may be used to model certain natural problems involving growth, decay and return to equilibrium.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the calculus of exponential and logarithmic functions, by:	*Students will* demonstrate problem-solving skills, by:
• estimating the values of the limits e and e^x	• evaluating maxima and minima of given functions involving exponential and logarithmic functions • finding areas bounded by exponential, logarithmic or reciprocal functions
• approximating the slopes of $y=e^x$ and $y=\ln x$ for some specific value of x • finding the derivative and antiderivative of the base-e exponential function • using limit theorems to evaluate the limits of simple exponential and logarithmic functions • finding the derivative of the natural logarithmic function	AND, in one or more of the following, by: • relating natural growth, natural decay and return to equilibrium to the differential equations $y'=ky$ or $y'=k(y-y_0)$ • solving natural growth and decay problems, starting from the equations $y'=ky$ or $y'=k(y-y_0)$
• finding the derivatives of logarithmic functions having bases other than e • finding the derivatives and antiderivatives of exponential functions having bases other than e	• fitting exponential models to observed data • calculating distance, velocity and acceleration for falling bodies, with air resistance present as part of the model
• computing $\int_a^b \frac{1}{x}\,dx$ and $\int_a^b e^{kx}\,dx$ • solving the differential equations $y'=ky$ and $y'=k(y-y_0)$.	• connecting the integral $\int_a^b \frac{dx}{px+q}$ with the integral $\int_a^b \frac{dx}{x}$.

NUMERICAL METHODS (Elective)

Overview

Limits and derivatives are sometimes difficult to compute using algebraic methods, but often can be calculated more easily using numerical approximations and estimates. In the case of definite integrals, most functions cannot be integrated exactly, and numerical methods are necessary. This unit has a balance between intuitive methods based on guess-and-test, and formal procedures, such as Simpson's rule for definite integrals.

Student Outcomes Summary

After completing this elective section, students will be expected to compute numerical approximations for limits, equation roots and definite integrals. They will be expected to relate these procedures to the fundamental concepts of calculus studied in the required sections of Mathematics 31, and to apply these concepts to a variety of relations, functions and equations. Finally, they will be expected to evaluate the reliability of a numerical procedure and to communicate the results of the evaluation.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that many limits, derivatives, equation roots and definite integrals can be found numerically, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the principles of numerical analysis, by:
• identifying and giving examples of the strengths and limitations of the use of technology in the computation of limits, derivatives and integrals	• describing the difference between an exact solution and an approximate solution • identifying when a particular numerical method is likely to give poor results
• computing limits of functions, using definitions, limit theorems and calculator/computer methods • computing derivatives of functions, using definitions, derivative theorems and calculator/computer methods	• explaining the difference between iterative and noniterative procedures • explaining the basis of the Newton–Raphson procedure for determining the roots of $f(x)=0$
• computing definite and indefinite integrals of simple functions, using antiderivatives, integral theorems and calculator/computer methods.	• describing the basis of a limit, derivative, equation root or integral procedure in geometric terms • connecting the number of subdivisions of the range of integration with the accuracy of the estimate for the integral • showing that all numerical integration formulas are procedures that interpolate between the lower and upper Riemann sums for the integral.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with numerical methods, by:	*Students will* demonstrate problem-solving skills, in one or more of the following, by:
• estimating the value of a limit by systematic trial and error • calculating the numerical value of the derivative at a point on a curve, whether or not there is a defining formula for the curve	• comparing the errors in computing definite integrals when using different procedures • writing computer software for the computation of limits, equation roots or definite integrals
• solving the equation $f(x)=0$ by systematic trial and error, and by the Newton–Raphson method	• reconstructing limit processes so that numerical evaluations can be efficient and reliable • evaluating the reliability of a numerical procedure for finding a limit, an equation root or a definite integral.
• calculating the upper and lower Riemann sums for a definite integral • calculating the value of a definite integral, using the midpoint rule • calculating the value of a definite integral, using the trapezoidal rule • calculating the value of a definite integral, using Simpson's rule.	

VOLUMES OF REVOLUTION (Elective)

Overview

Volumes of solids may be calculated using triple integrals, but for volumes formed by revolving the graphs of simple functions about the x- or y-axis, a single integration will suffice. By using limits to find an infinite sum of cylindrical volumes, a value for a volume of revolution can be found.

Student Outcomes Summary

After completing this elective section, students will be expected to find volumes of revolutions of the graphs of simple polynomial and trigonometric functions by using the "disc" method. Students will be expected to relate this procedure to that of finding the area between the graph of a function and the x-axis by the limit of the sum of a set of rectangles whose widths approach zero (a Riemann sum).

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that volumes of revolution may be considered as the limiting sum of smaller volumes and can be related to definite integrals, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of volumes of revolution, by:
• describing the connections between the operation of integration and the finding of areas and averages	• identifying the solid generated by the rotation of the graph of a function, either between two boundary values, or between two graphs
• combining and modifying familiar solution procedures to form a new solution procedure to a related problem	• explaining the connection between the volume of revolution and the volume of a cylindrical disc
• computing definite and indefinite integrals of simple functions, using antiderivatives, integral theorems and calculator/computer methods	• demonstrating how the formula for the volume of revolution by the disc method could be generated.
• using the connections between a given problem and either a simpler or equivalent problem, or a previously solved problem, to solve the given problem.	

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with volumes of revolution, by:	*Students will* demonstrate problem-solving skills, in one or both of the following, by:
• using the relationship $V = \pi \int_a^b [f(x)]^2 dx$ to find the volume of revolution between the boundaries of a and b for polynomial and trigonometric functions	• deriving formulas for the volume of a cylinder, cone and sphere
• finding the volume of revolution between two polynomial or trigonometric functions by first finding the intersection points of the graphs of the two functions.	• revolving the graph of a function about a horizontal or vertical line, other than the x- or y-axis, and finding the resulting volume of revolution.

APPLICATIONS OF CALCULUS TO PHYSICAL SCIENCES AND ENGINEERING
(Elective)

Overview

Calculus is used extensively in physical sciences and in engineering. The study of energy, forces and motion can be represented in terms of differential equations that involve algebraic and trigonometric functions of time. These differential equation models, together with their solutions, can be used to make hypotheses and predictions.

Student Outcomes Summary

After completing this elective section, students will be expected to construct differential equation models for simple physical science and engineering situations, and to solve those models that involve algebraic and trigonometric functions of time.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that most of the important equations of physics are differential equations, and calculus provides the most efficient solution method, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the links among calculus, the physical sciences and engineering, by:
• linking displacement, velocity and acceleration of an object moving in a straight line with nonuniform velocity	• illustrating situations in which differential equations are required to represent problems
• describing the connections between the operation of integration with the finding of areas and averages	• developing one or more differential equations in the areas of linear motion, simple harmonic motion, work, hydrostatic force, moments of inertia, radioactive decay or similar situations
• calculating the displacement, velocity and acceleration of an object moving in a straight line with nonuniform velocity	
• calculating the mean value of a function over an interval	• showing that the concept of mean value can be applied to situations where the quantity varies with time, or where a range of values exists in a system of multiple bodies.
• producing approximate answers to complex calculations by simplifying the models used	
• constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable	
• fitting mathematical models to situations described by data sets.	

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the application of calculus to the physical sciences and engineering, by:	*Students will* demonstrate problem-solving skills, in one of the following, by:
• solving differential equations of type $y''(t)=f(t)$	• determining the half-life, the decay rate, and the activity as a function of time for a radioisotope
• solving differential equations of type $y''(t)=-k^2y$	• analyzing the motion and energy in an oscillating spring system (Hooke's law) • analyzing hydrostatic forces on the surface of submerged objects
• calculating the work done by any nonuniform force $f(x)$ using $W=\int_a^b f(x)dx$ • determining root-mean-square values for sinusoidal functions.	• determining the moment of inertia for rigid bodies • determining the centre of mass for individual bodies and for systems of bodies • integrating Newton's second law when expressed in the form $mx''(t)=f(x)$.

APPLICATIONS OF CALCULUS TO BIOLOGICAL SCIENCES (Elective)

Overview

Many biological problems are concerned with rates of growth, rates of decay, and rates of transport of energy and materials across boundaries. Mathematical solutions to many of these problems can be found by constructing differential equation models that have solutions involving exponential and logarithmic functions. This elective, together with the elective Calculus of Exponential and Logarithmic Functions, can be taught as an integrated whole.

Student Outcomes Summary

After completing this elective section, students will be expected to construct differential equation models for simple biological situations, and to solve those models that involve exponential and logarithmic functions.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that many important biological applications of calculus are connected with models involving the solution of the differential equation $f'(x) = kf(x)$, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the links between calculus and the biological sciences, by:
• combining and modifying familiar solution procedures to form a new solution procedure to a related problem	• defining exponential and logarithmic functions as inverse functions
• using the connections between a given problem and either a simpler or equivalent problem, or a previously solved problem, to solve the given problem	• explaining the special properties of the number e, together with a definition of e as a limit
• producing approximate answers to complex calculations by simplifying the models used	• illustrating that the derivative of an exponential or logarithmic function may be derived from the definition of the derivative
• constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable	• illustrating how differential equations may be used to model certain biological problems involving growth, decay and movement across a boundary.
• fitting mathematical models to situations described by data sets.	

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the application of calculus to the biological sciences, by:	*Students will* demonstrate problem-solving skills, by:
• estimating the values of the limits e and e^x • using limit theorems to evaluate the limits of simple exponential and logarithmic functions • approximating the slopes of $y=e^x$ and $y=\ln x$ for some specific value of x • finding the derivative of the natural logarithmic function	• relating natural growth, natural decay and return to equilibrium to the differential equations $y'=ky$ or $y'=k(y-y_0)$ • solving natural growth and decay problems starting from the equations $y'=ky$ or $y'=k(y-y_0)$ AND, either, by: • fitting differential equation models to observed biological data
• finding the derivative and antiderivative of the base-e exponential function • using methods of guess-and-test, and comparing coefficients to solve the differential equations $y'=ky$ and $y'=k(y-y_0)$ • verifying that $y=Ae^{kx}$ satisfies the differential equation $y'=ky$.	OR, both of the following, by: • relating growth subject to limits to the logistic equation $y'=ky(L-y)$ • solving logistic equation models, and estimating values for the parameters k and L, from experimental data.

APPLICATIONS OF CALCULUS TO BUSINESS AND ECONOMICS (Elective)

Overview

Although there are far too many variables and influences present to make a complete analysis of economic situations, many of them can be simplified to a point where Mathematics 31 students can begin to understand the applications of calculus to this area of study.

Student Outcomes Summary

After completing this elective section, students will be expected to analyze an economic model based on the need to maximize revenue and profit while minimizing cost.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that calculus may be used as a tool to analyze situations in business and economics that involve revenue, profit and cost, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the links among calculus, business and economics, by:
• relating the zeros of the derivative function to the critical points on the original curve	• explaining how calculus procedures frequently arise in models used in business and economics
• producing approximate answers to complex calculations by simplifying the models used	• explaining how both maximum and minimum values are important in the making of business and economic decisions.
• constructing mathematical models for situations in a broad range of contexts, using algebraic and trigonometric functions of a single real variable	
• determining the optimum values of a variable in various contexts, using the concepts of maximum and minimum values of a function	
• using the concept of critical values to sketch the graphs of functions, and comparing these sketches to computer-generated plots of the same functions	
• fitting mathematical models to situations described by data sets.	

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the application of calculus to business and economics, by:	*Students will* demonstrate problem-solving skills, in one or both of the following, by:
• sketching polynomial, exponential and trigonometric functions of one variable	• determining a revenue, profit or cost function from a problem situation that can be modelled, using polynomial functions
• using a given revenue, profit or cost function to calculate and justify optimum values • finding the maximum of a revenue or profit function that is expressed as a function of price or number sold • finding the minimum of a cost function that is expressed as a function of price or number sold.	• modelling the business cycle, using trigonometric functions.

CALCULUS THEOREMS (Elective)

Overview

The simple geometric representations of limit, continuity, derivative and integral work well for most functions used in problem applications. However, it is possible to give examples of misleading conclusions when these representations are being used. This elective section shows these examples and leads the student into a deeper knowledge, and the proofs, of the basic limit, derivative and integral theorems.

Student Outcomes Summary

After completing this elective section, students will be expected to illustrate the differences between intuitive proofs and rigorous proofs in the context of proof, construct a counterexample to a hypothesis, and construct a rigorous proof of one of the simpler limit, derivative or integral theorems.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that limit, derivative and integral theorems can be proved at different levels of rigor, from intuitive to analytic, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the nature of proof in the context of limit, derivative and integral theorems, by:
• giving examples of the differences between intuitive and rigorous proofs in the context of limits, derivatives and integrals	• proving the equivalence of the product and the quotient rule for derivatives
• calculating the mean value of a function over an interval	• comparing the nature of intuitive and rigorous proofs knowing the conditions under which a theorem is true
• constructing geometrical proofs at an intuitive level that generalize the concepts of slope, area, average and rate of change.	• explaining what is an example, and what is a counterexample
	• illustrating the intermediate value theorem, Rolle's theorem, the mean value theorem and the fundamental theorem of calculus, by examples and counterexamples, using both graphical and algebraic formulations.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with the construction of proofs of limit, derivative and integral theorems, by:	*Students will* demonstrate problem-solving skills, by:
• using specific functions to illustrate the equivalence of the product and quotient rules	• composing rigorous proofs for derivative theorems, starting from the corresponding limit theorems
• locating an error in a given proof of a calculus theorem	AND, in one of the following, by:
	• deriving formulas for the derivatives of complicated functions, using the basic rules; e.g., functions, such as $y=\frac{f(x)g(x)}{h(x)}$ or $y=f(g(h(x)))$
• verifying the mean value theorem and the fundamental theorem of calculus for specific examples.	• proving that a differentiable function satisfies the mean value theorem
	• constructing, and justifying, an iterative solution procedure for the equation $f(x)=c$, using the intermediate value theorem.

FURTHER METHODS OF INTEGRATION
(Elective)

Overview

Certain algebraic and trigonometric functions cannot be integrated using the usual methods involving the power rule. It is therefore necessary to look at other methods; these being integration by substitution, integration by parts, or integration by partial fractions.

Student Outcomes Summary

After completing this elective section, students will be expected to recognize which particular method of integration is needed. They will also be expected to use and combine these methods appropriately in evaluating with indefinite and definite integrals.

GENERAL LEARNER EXPECTATIONS	CONCEPTUAL UNDERSTANDING
Students are expected to understand that integration by substitution, by parts, and by partial fractions are procedures necessary when dealing with certain algebraic and trigonometric functions, and demonstrate this, by:	*Students will* demonstrate conceptual understanding of the methods of integration, by:
• recognizing that integration can be thought of as an inverse operation to that of finding derivatives	• identifying integrals that cannot be evaluated, using the antiderivatives of polynomial or trigonometric functions
• expressing final algebraic and trigonometric answers in a variety of equivalent forms, with the form chosen to be the most suitable form for the task at hand	• showing how substitutions into a definite integral change both the function to be integrated and the limits of integration
• computing definite and indefinite integrals of simple functions, using antiderivatives, integral theorems and calculator/computer methods	
• using the connections between a given problem and either a simpler or equivalent problem, or a previously solved problem, to solve the given problem.	• recognizing when it would be appropriate to use integration by substitution, by parts or by partial fractions.

PROCEDURAL KNOWLEDGE	PROBLEM-SOLVING CONTEXTS
Students will demonstrate competence in the procedures associated with methods of integration, by:	*Students will* demonstrate problem-solving skills, by:
	• deriving the formula for integration by parts, using the formula for the derivative of a product
• using a change of variable to integrate by substitution	• combining two or more methods to integrate a rational algebraic function
• using a trigonometric substitution to integrate algebraic functions containing terms, such as $\sqrt{a^2-x^2}$	• adapting integration methods for antiderivatives to the evaluation of definite integrals.
• using a trigonometric identity as a first step in an integration by substitution	
• using integration by parts to integrate a product	
• writing a rational function as a sum of partial fractions	
• using integration by partial fractions to integrate rational algebraic functions.	

MATHEMATICS 14-24

A. PROGRAM RATIONALE AND PHILOSOPHY

To set goals and make informed choices, students need an array of thinking and problem-solving skills. Fundamental to this is an understanding of mathematical techniques and processes that will enable them to apply the basic skills necessary to address everyday mathematical situations, as well as acquire higher order skills in logical analysis and methods for making valid inferences.

A knowledge of mathematics is essential for a well-educated citizenry. However, the need for and use of mathematics in the life of the average citizen is changing. Emphasis has shifted from the memorization of mathematical formulae and algorithms toward a more dynamic view of mathematics as a precise language, used to reason, interpret and explore. There continues to be a need for the logical development of concepts and skills as a basis for the appropriate use of mathematical information to solve problems. Moreover, the use of available technology along with techniques such as estimation and simulation, incorporated with more traditional problem-solving techniques, are the tools with which mathematical problems are solved.

Change in the way in which mathematics is used is necessitating a concurrent change in the emphases of mathematics education. Students need an expanded list of fundamental concepts but will also need to understand the ideas that make up those concepts and how they are related. They also require a familiarity with their applications. Most important, students have to be able to solve problems using the mathematical processes developed, and be confident in their ability to apply known mathematical skills and concepts in the acquisition of new mathematical knowledge. In addition, the ability of technology to provide quick and accurate computation and manipulation, to enhance conceptual understanding and to facilitate higher order thinking, should be recognized and used by students.

The majority of students who enter senior high school exhibit mainly concrete operational behaviours with regard to mathematics. It is recognized that senior high school mathematics courses include many abstract understandings that students are expected to acquire. The course content of the Senior High School Mathematics Program is cognitively appropriate for the students and should be presented in a way that is consistent with the students' ability to understand.

The Senior High School Mathematics Program includes the course sequences Mathematics 16–26, 14–24, 13–23–33 and 10–20–30, plus Mathematics 31. Transfer by students among courses of different sequences is possible. The course sequences commensurate with differing abilities, interests and aspirations, are designed to enable students to have success in mathematics. As well, the mathematics program reflects the changing needs of society,

and provides students with the mathematical concepts, skills and attitudes necessary to cope with the challenges of the future.

The Mathematics 14–24 sequence is designed for students whose needs, interests and abilities focus on basic mathematical understanding. The emphasis is on the acquisition of practical life skills and students are provided with opportunities to improve their skills in working with mathematics. Students who successfully complete Mathematics 24 may choose to enter directly into a job or select from a limited number of trade programs. The mathematics requirement for the General High School Diploma consists of two courses in mathematics; e.g., Mathematics 14 and Mathematics 24.

B. GENERAL LEARNER EXPECTATIONS

Upon conclusion of their senior high mathematics education, students will be expected to be mathematically literate. **Mathematical literacy** refers to students' ability and inclination to manage the demands of their world through the use of mathematical concepts and procedures to communicate, reason and solve problems. More specifically, *students will be expected to:*

- have achieved understanding of the basic mathematical concepts, and developed the skills and attitudes needed to become responsible and contributing members of society
- apply basic mathematical skills and concepts in practical situations
- have developed the skills, concepts and attitudes that will ensure success in the mathematical situations that occur in future educational endeavours, employment and everyday life
- have developed the skills, concepts and attitudes that will enable the acquisition of mathematical knowledge beyond the conclusion of secondary education
- have developed critical and creative thinking skills
- be able to communicate mathematical ideas effectively
- understand how mathematics can be used to investigate, interpret and make decisions in human affairs
- understand how mathematics can be used in the analysis of natural phenomena
- understand the connections and interplay among various mathematical concepts and between mathematics and other disciplines
- understand and appreciate the positive contributions of mathematics, as a science and as an art, to civilization and culture.

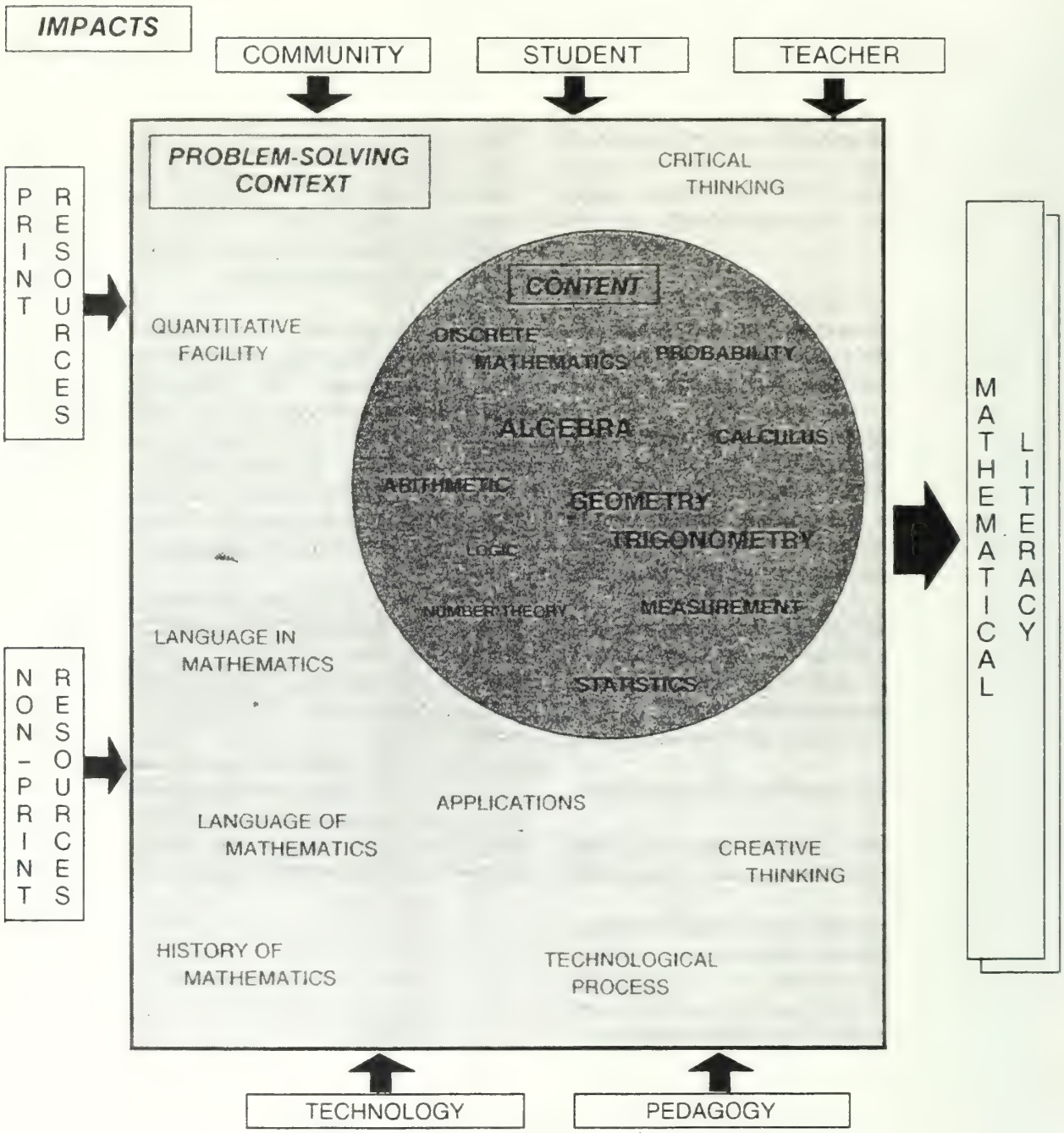
A General Model for Mathematical Literacy for Senior High School Programs is presented on the following page and outlines the factors that affect what and how students learn as they become mathematically literate. The model is fluid in that the content can be learned within a problem-solving context that engages any of a number of vehicles as the learning focus. At the same time, the students involved in the learning situation are affected in what and how they learn by forces that have impact upon them.

The **Content** of the Senior High School Mathematics Program is the body of knowledge that is to be acquired by students. In the various senior high school mathematics courses, it is made up of topics that can be categorized into one or more of the listed strands.

Within each course in the Senior High School Mathematics Program, students will focus on problem solving. The **Problem-Solving Context** refers to the instructional emphases within which the specific content expectations can be acquired. The various entries indicated within the model suggest processes that belong to the problem-solving context and may be used by students as vehicles for learning the content.

The **Impacts** on the problem-solving context are those skills, attitudes and experiences that are possessed by the students and teachers involved, as well as the resources they may use throughout the learning process. They include the influence exerted by the culture and beliefs of the community as reflected by the school. The effectiveness of the context in enabling a student to acquire the content is dependent upon the skillful management by the teacher of those items that impact upon a student's learning.

A GENERAL MODEL FOR MATHEMATICAL LITERACY FOR SENIOR HIGH SCHOOL PROGRAMS



C. SPECIFIC LEARNER EXPECTATIONS

PROGRAM ORGANIZATION

The major part of the content of each senior high school mathematics course consists of topics required of all students who take the course. The required content comprises 80% of the course and contains the concepts, skills and attitudes that all students are expected to acquire. As well, the required portion of all courses includes specific expectations in regard to problem solving and the use of technology.

Each course includes a compulsory component comprising 20% of the course, made up of elective material that is consistent with the content and expectations of the required component. The purpose of the elective is to provide for enrichment, remediation, or innovative or experimental presentations or activities. It is not intended to provide acceleration or advanced placement. However, horizontal enrichment and extension is appropriate and students should have access to elective material that serves their individual needs and interests.

Mathematics 14 is a 5-credit course. Mathematics 24 is a 3- or a 5-credit course organized into twelve units within five themes. It is important that teachers address each of the five themes as well as provide for the specific needs of their individual classes. The required component of Mathematics 24 courses offered for 3 credits will be made up of attitudes, problem solving, numeration, and geometry and measurement as well as six units, including one unit from each of the five themes, plus any one other unit selected from any of the themes, chosen according to the needs and interests of the students in the class. The required component of Mathematics 24 courses offered for 5 credits will be made up of attitudes, problem solving, numeration, and geometry and measurement as well as ten units, including one unit from each of the five themes, plus any five other units chosen from any of the themes. The elective component in Mathematics 24 for 3 or 5 credits will be in addition to the above. The elective component may include any units not used in the required component, chosen according to the needs and interests of the students in the class.

The themes and the units within them are:

WORK
- Income
- Income Tax

BANKING
- Personal Banking
- Consumer Credit

TRANSPORTATION
- Purchasing a Vehicle
- Operating a Vehicle
- Travelling

ACCOMMODATION
- Renting and Purchasing a Home
- Mortgage and Household Insurance
- Building, Decorating and Furnishing

COST OF INDEPENDENCE
- Budgets and Getting Value for Money Spent
- Life and Health Insurance

Evaluation of students in the Senior High School Mathematics Program will involve assessment of the level of achievement of all of the learner expectations, including concepts, skills and attitudes, as well as problem solving and technological expectations. For more information regarding evaluation, consult the appropriate teacher resource manuals.

PROGRAM STRUCTURE

At the beginning of each course is a list of attitude expectations. These attitudes embody a mathematical attitude or frame of mind for a student to view the world. The attitude expectations should be woven into the fabric of the entire course.

Following this are the problem-solving expectations that outline a variety of procedures, strategies, skills and checking techniques for solving problems. Because a major purpose for studying mathematics is to learn to solve problems, problem-solving expectations occur throughout all areas of the specific learner expectations. Students must have the

background skills and knowledge necessary to achieve these expectations successfully, using problem-solving techniques.

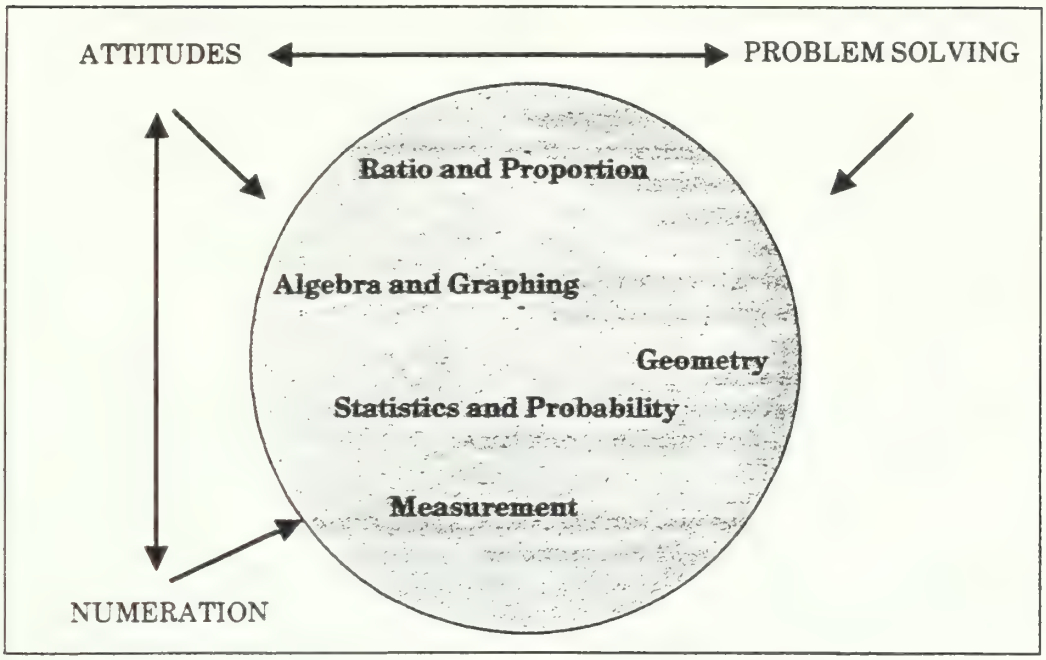
The units of the course are broken into a number of concepts. A concept is an abstract or general idea about specific instances that have common properties or an identifiable relationship to one another. The concepts are presented as mathematical definitions or theorems, or as statements of mathematical ideas or abstractions. In the course of studies, concepts are stated as "*Students will be expected to* demonstrate an understanding that . . ."

Supporting each concept are a number of skills. Skills are intellectual or physical capabilities that will be developed within the context of the particular concept. In the course of studies, skills are stated as "*Students will be expected to . . .*"

Skills specifically related to the use of technology identify areas in which calculators and/or computer technology are applied by students as tools to be used for calculation, manipulation or graphing, or to aid in the analysis of problems. Technological expectations are defined explicitly throughout the learner expectations. In many cases, a particular technology is indicated for investigation or analysis. It is in these situations that the use of technology enables students to engage in critical and creative thinking and problem solving.

Students will be expected to learn how and when to use a calculator and have a demonstrated proficiency in estimation and mental arithmetic. To use calculators effectively, they must be able to judge the reasonableness of an answer and understand the importance of making a judgment about the result of a calculation.

MATHEMATICS 14 PROGRAM STRUCTURE



ATTITUDES

1. *Students will be expected to* demonstrate an attitude associated with mathematical literacy. In particular, *students will be expected to*:

   1.1 be confident in their mathematical knowledge and in their ability to acquire new knowledge
   1.2 demonstrate persistence, resolve, flexibility and ingenuity in finding the solution to problems
   1.3 develop intellectual curiosity and openness to new ideas, insights and change in the pursuit of mathematical knowledge
   1.4 exhibit an attitude of curiosity and spontaneity and appreciate creativity and innovation in representing situations mathematically
   1.5 be critical and constructive in approaching new ideas and new processes
   1.6 be aware of the importance of communication skills in mathematics
   1.7 appreciate the usefulness of computational competence, mathematical processes and problem-solving skills that are used in the decision-making and modeling processes in our society
   1.8 appreciate the contributions of mathematics to our culture and civilization.

PROBLEM SOLVING

1. *Students will be expected to* demonstrate an understanding of the variety of procedures that can be used to understand problems. In particular, *students will be expected to*:

    1.1 read the problem thoroughly
    1.2 identify and clarify key components
    1.3 restate the problem, using familiar terms
    1.4 evaluate the given information as to sufficiency and relevancy
    1.5 interpret pictures, charts and graphs
    1.6 determine hidden assumptions
    1.7 ask relevant questions
    1.8 identify given, needed and wanted information
    1.9 diagram or model the problem situation
    1.10 use suitable notation
    1.11 determine valid inferences
    1.12 simulate a problem situation
    1.13 formulate situations into identifiable problems.

2. *Students will be expected to* develop a variety of strategies for use in the solution of mathematical problems. In particular, *students will be expected to*:

    2.1 conduct an investigation
    2.2 use estimation and approximation
    2.3 develop equations or use formulae
    2.4 use flow charts
    2.5 make lists and charts
    2.6 look for patterns
    2.7 work backward
    2.8 break the problem into smaller parts
    2.9 look for a simpler or related problem
    2.10 make diagrams or models
    2.11 use manipulatives
    2.12 choose and sequence a series of mathematical operations
    2.13 sketch the graph of a problem situation
    2.14 establish procedures to gather and organize data
    2.15 apply empirical or inductive processes
    2.16 use geometric construction and measurement techniques
    2.17 make and test a conjecture.

3. *Students will be expected to* develop a variety of skills that can be used to carry out the plan for the solution of a problem. In particular, *students will be expected to*:

    3.1 apply selected strategies
    3.2 present ideas clearly
    3.3 document the solution process
    3.4 use appropriate group behaviours
    3.5 use calculators and computers
    3.6 evaluate problem-solving strategies for effectiveness
    3.7 alter or abandon non-productive strategies
    3.8 search for additional information
    3.9 ask questions
    3.10 be open to inspirations, intuitions and "bright ideas".

4. *Students will be expected to* employ a variety of skills to help them look back over the solution of a problem. In particular, *students will be expected to*:

   4.1 determine the reasonableness of an answer
   4.2 explain the solution in oral or written form
   4.3 consider the possibility of additional solutions
   4.4 search for other strategies and processes of solution
   4.5 create and solve similar problems
   4.6 note the characteristics that will be identifiable in similar problems
   4.7 make a generalization
   4.8 examine the assumptions made and simplifications and modifications used for accuracy, effectiveness and efficiency.

NUMERATION

Numeration concepts and calculation skills are basic in order to address successfully any mathematical situation. Since it is the intent to integrate the development of these concepts and skills into the other expectations of this course, it is not expected that numeration will be taught as a topic on its own.

1. *Students will be expected to* demonstrate an understanding that computation requires skills in addition, subtraction, multiplication and division with whole numbers, integers and rational numbers and can be done mentally, with paper and pencil, and with electronic calculators, as appropriate to a particular situation.

   Mental Computation

   Students will be expected to:

   1.1 add and subtract whole numbers, integers and rational numbers (limit: add three single-digit integers; subtract two single-digit integers; add and subtract two multiples of 5 and 10 up to 100; add and subtract fractions with common denominators; add and subtract tenths and hundredths written in decimal form)
   1.2 multiply whole numbers, integers and rational numbers (limit: single-digit numbers, multiples of 5 and 10 multiplied by a single-digit multiplier; double any number up to 50; multiply whole numbers, integers and decimals by powers of 10)
   1.3 square integers up to 10, and calculate square roots of integral perfect squares up to 100
   1.4 divide whole numbers, integers and rational numbers (limit: divide integers to 100 that are perfect multiples of single-digit divisors; halve even integers to 50; divide whole numbers, integers and decimals by powers of 10)
   1.5 determine whether a whole number or integer is divisible by 2, 3, 4, 5 or 10
   1.6 transform fractions to percents (limit: denominators of 2, 3, 4, 5, 10, 100) and whole number percents
   1.7 calculate the percent of given whole number quantities (limit: 1%, 10%, 25%, 50%, 100%, 200%)
   1.8 recognize "families" of fractions (tenths, twelfths, sixteenths) and transform fractions within families to common denominators.

Paper and Pencil Computation

Students will be expected to:

1.9 add and subtract whole numbers, integers and rational numbers (limit: add three 2-digit integers; subtract 3-digit integers; add and subtract two fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 16; add three 2-digit decimals; subtract 2-digit decimals)
1.10 multiply whole numbers, integers and rational numbers (limit: 2-digit integers, 2-digit decimals, fractions with single-digit denominators and denominators that are multiples of 10)
1.11 divide whole numbers, integers and rational numbers (limit: 3-digit integers that are perfect multiples of single-digit divisors; halve even numbers up to 500)
1.12 calculate the percent of given quantities (limit: 5%, 15%, 25% and multiples of 10%)
1.13 calculate the value of a power (limit: whole number base <10 and exponent of 2 or 3)
1.14 transform mixed numbers to decimals and percents (limit: denominators of 2, 3, 4, 5, 6, 8, 10).

Calculation with Calculators

Students will be expected to:

1.15 calculate the percent of given quantities
1.16 calculate the value of a power (limit: integral base and whole number exponent)
1.17 calculate the square root of any positive rational number
1.18 transform any rational number to decimal and percent form.

2. *Students will be expected to* demonstrate an understanding that rounding, estimation and approximation are fundamental to facility in calculation.

Students will be expected to:

2.1 round given values to a specified level of precision
2.2 round solutions to an appropriate level of precision
2.3 use estimation techniques to predict solutions to calculations.

3. *Students will be expected to* demonstrate an understanding that checking an answer for reasonableness and accuracy is a fundamental step in the calculation process and that the level of accuracy required is dependent upon the particular situation.

Students will be expected to:

3.1 use estimation techniques to check a calculation for reasonableness
3.2 determine if the accuracy of a calculated answer is adequate for a given situation.

RATIO AND PROPORTION

1. *Students will be expected to* demonstrate an understanding that a ratio is a way of comparing the relative sizes of two quantities.

Students will be expected to:

1.1 compare two quantities, using ratios in the form $\frac{a}{b}$, a:b, and a to b.

2. *Students will be expected to* demonstrate an understanding that a rate is a ratio between quantities that have different units.

Students will be expected to:

2.1 calculate rates and unit rates

2.1.1 solve problems involving the use of rates and unit rates.

3. *Students will be expected to* demonstrate an understanding that proportions are equations made up of equivalent ratios.

Students will be expected to:

3.1 calculate the unknown value in a proportion

3.1.1 solve problems using proportions.

4. *Students will be expected to* demonstrate an understanding that a percent is a ratio in which a quantity is compared to 100.

Students will be expected to:

4.1 express ratios as percents and decimals and vice versa
4.2 solve for the unknown element in a percentage calculation

4.2.1 solve problems that involve the use of percents.

STATISTICS AND PROBABILITY

1. *Students will be expected to* demonstrate an understanding that data collected from a sample must be organized, presented and analyzed in order that valid inferences can be drawn.

Students will be expected to:

1.1 use the terms sample and population
1.2 determine a suitable sample from a given population

1.2.1 assess the suitability of a sample chosen from a given population

1.3 organize data using tally sheets, frequency tables and stem-and-leaf plots

1.3.1 design and carry out a simple statistical project involving the collection, organization, presentation and analysis of data gathered from an appropriate sample

1.4 interpret and analyze data represented by pictographs, circle graphs, bar graphs, line graphs, and histograms
1.5 identify the characteristics of a misleading graphical display
1.6 determine and calculate appropriate measures of central tendency

1.6.1 solve problems that involve the use of an appropriate measure of central tendency in the analysis of sets of data

1.7 make inferences and generalizations about a population from which a sample was taken.

2. *Students will be expected to* demonstrate an understanding that a probability is a numerical measure of the likelihood of an event and can take values from 0 through 1.

Students will be expected to:

2.1 list the sample spaces for simple experiments or simulations
2.2 use counting techniques, such as tree diagrams, to find the number of possible outcomes of an experiment
2.3 express the probability of an event from a given situation, simple experiment or simulation

2.3.1 perform an investigation to find the experimental probability of an event.

GEOMETRY

1. *Students will be expected to* demonstrate an understanding that two- and three-dimensional geometric figures can be classified and have characteristics that uniquely define them.

Students will be expected to:

1.1 classify polygons according to the number of sides
1.2 classify triangles and quadrilaterals by sides and angles
1.3 determine the sum of the interior angles of a polygon

1.3.1 perform an investigation to determine the sum of the interior angles of any polygon

1.4 classify the following common geometric solids: rectangular prisms, pyramids, cylinders, cones and spheres

1.4.1 perform an investigation to determine the relationship amongst the edges, faces and vertices of polyhedra
1.4.2 draw nets that define simple polyhedra
1.4.3 use nets to construct simple polyhedra

1.5 identify and define the following terms associated with a circle; such as radius, diameter, circumference, semicircle.

2. *Students will be expected to* demonstrate an understanding that geometric figures can be defined uniquely, and that these unique characteristics can be reproduced using construction techniques and geometric instruments.

Students will be expected to:

2.1 construct a line segment of given length, or congruent to a given segment
2.2 draw an angle of a given size, or construct an angle congruent to a given angle
2.3 construct the perpendicular bisectors of segments and angles
2.4 draw regular polygons
2.5 construct a circle of given radius
2.6 use a combination of construction techniques

2.6.1 construct angles of 90°, 45°, 60° and 30°
2.6.2 use construction techniques in the construction or reproduction of geometric figures or designs.

3. *Students will be expected to* demonstrate an understanding that similar geometric figures have the same shape but may differ in size, that corresponding angles are equal, and that the lengths of corresponding sides are proportional.

   Students will be expected to:

   3.1 use the relationship between the lengths of the sides of similar triangles to calculate the lengths of unknown sides

      3.1.1 solve problems, using the properties of similar polygons

   3.2 recognize congruency as similarity in which the size of the figures is the same.

4. *Students will be expected to* demonstrate an understanding of the Pythagorean theorem.

   Students will be expected to:

   4.1 use the Pythagorean theorem to find the length of a side in a right triangle

      4.1.1 solve problems involving right triangles by using the Pythagorean theorem.

5. *Students will be expected to* demonstrate an understanding that angles formed by intersecting lines relate to each other.

   Students will be expected to:

   5.1 identify parallel, intersecting and perpendicular lines
   5.2 identify and recognize the characteristics of the relationship between supplementary, complementary and vertical angles

      5.2.1 perform an investigation to determine the properties of the angles between intersecting lines
      5.2.2 solve problems involving the relationships amongst intersecting and parallel lines and the angles they form to solve problems involving the measure of unknown angles.

MEASUREMENT

1. *Students will be expected to* demonstrate an understanding that standard units of measure for length, mass, and volume provide consistency and accuracy and that the most widely used and accepted measurement system is the SI (metric) system.

   Students will be expected to:

   1.1 recognize the basic SI units of measurement for length (metre (m)), mass (kilogram (kg)), (tonne (t)), and volume of liquids or gases (litre (L))
   1.2 use the appropriate SI measures for length, mass and liquid/gas volume (limit: kg, g, L, mL, m, cm, mm, km)
   1.3 express equivalences amongst units of length, of mass and of volume
   1.4 recognize non-metric units of measurement still in common use.

2. *Students will be expected to* demonstrate an understanding that perimeter is the measure of the distance around a geometric figure.

   Students will be expected to:

   2.1 calculate the perimeter of polygons

      2.1.1 calculate the perimeter of irregular shapes and objects

   2.2 calculate the circumference of a circle by using a formula

      2.2.1 solve problems that involve finding the circumference of circles and circular regions.

3. *Students will be expected to* demonstrate an understanding that area is the number of unit squares that are enclosed within the boundaries of a geometric figure.

   Students will be expected to:

   3.1 calculate the area of triangles and quadrilaterals by using formulae (limit: triangles, quadrilaterals)

      3.1.1 solve problems that involve finding the area of triangles and rectangles

   3.2 find the area of a circle by using a formula

      3.2.1 solve problems that involve finding the area of circles.

4. *Students will be expected to* demonstrate an understanding that volume is the number of unit cubes that are within a geometric solid.

   Students will be expected to:

   4.1 calculate the volume of rectangular prisms and cylinders by using formulae

      4.1.1 solve problems that involve calculating the volume of rectangular prisms and cylinders.

5. *Students will be expected to* demonstrate an understanding that time can be measured in seconds, minutes, hours, days, weeks, months and years.

   Students will be expected to:

   5.1 change units of time from one form to another
   5.2 tell time, using a 24-hour clock
   5.3 write times using proper 24-hour notation
   5.4 perform calculations, using units of time.

6. *Students will be expected to* demonstrate an understanding that temperature can be measured in degrees.

   Students will be expected to:

   6.1 measure temperatures using the Celsius scale
   6.2 perform calculations involving the use of temperature measured in Celsius.

ALGEBRA AND GRAPHING

1. *Students will be expected to* demonstrate an understanding that algebraic expressions can be used to represent situations where one or more values can vary.

   Students will be expected to:

   1.1 write first degree algebraic expressions to illustrate simple mathematical situations with a maximum of two variables
   1.2 evaluate algebraic expressions for replacement values of the variables

      1.2.1 solve problems that involve the evaluation of expressions for values of the variables

   1.3 solve first degree equations in one variable through the use of guess-and-test techniques, concrete manipulatives and formal methods (limit: $x+a=b$, $ax=b$, $ax+b=c$, $\frac{x}{a}=b$)

      1.3.1 solve problems that can be represented by first degree equations in one variable
      1.3.2 use calculators to aid in the solution of equations.

2. *Students will be expected to* demonstrate an understanding that two variables can be related and that those relationships can be expressed by sets of ordered pairs, equations and graphs.

   Students will be expected to:

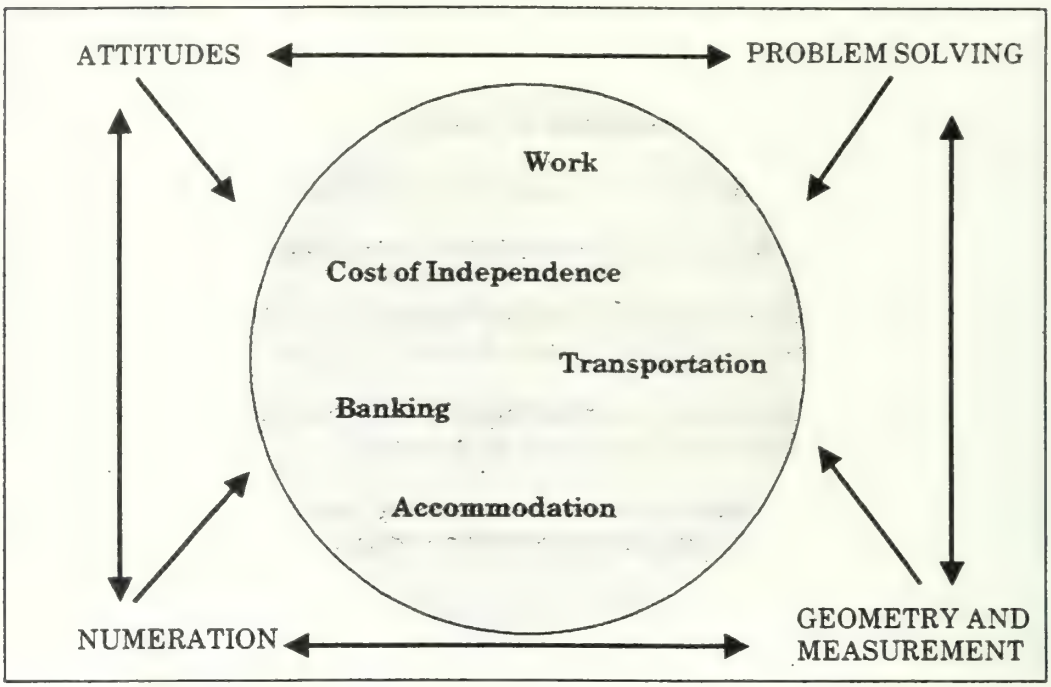
   2.1 describe the relationships between two variables, verbally and in writing

      2.1.1 determine the algebraic relationship between two variables by informal means, such as guess-and-test

   2.2 plot points on a coordinate plane
   2.3 plot the points and sketch the graphs that describe the relationship between two variables
   2.4 construct tables of values that satisfy given linear equations in two variables
   2.5 sketch graphs from tables of values that satisfy a given linear equation in two variables
   2.6 read and interpret the graphs that describe the relationship between two variables

      2.6.1 analyze graphs that describe the relationship between physical variables by the use of interpolation and extrapolation techniques.

MATHEMATICS 24 PROGRAM STRUCTURE



ATTITUDES

1. *Students will be expected to* demonstrate an attitude associated with mathematical literacy. In particular, *students will be expected to*:

   1.1 be confident in their mathematical knowledge and in their ability to acquire new knowledge
   1.2 demonstrate persistence, resolve, flexibility and ingenuity in finding the solution to problems
   1.3 develop intellectual curiosity and openness to new ideas, insights and change in the pursuit of mathematical knowledge
   1.4 exhibit an attitude of curiosity and spontaneity and appreciate creativity and innovation in representing situations mathematically
   1.5 be critical and constructive in approaching new ideas and new processes
   1.6 be aware of the importance of communication skills in mathematics
   1.7 appreciate the usefulness of computational competence, mathematical processes and problem-solving skills that are used in the decision-making and modeling processes in our society
   1.8 appreciate the contributions of mathematics to our culture and civilization.

PROBLEM SOLVING

1. *Students will be expected to* demonstrate an understanding of the variety of procedures that can be used to understand problems. In particular, *students will be expected to*:

   1.1 read the problem thoroughly

1.2 identify and clarify key components
1.3 restate the problem, using familiar terms
1.4 evaluate the given information as to sufficiency and relevancy
1.5 interpret pictures, charts and graphs
1.6 determine hidden assumptions
1.7 ask relevant questions
1.8 identify given, needed and wanted information
1.9 diagram or model the problem situation
1.10 use suitable notation
1.11 determine valid inferences
1.12 simulate a problem situation
1.13 formulate situations into identifiable problems.

2. *Students will be expected to* develop a variety of strategies for use in the solution of mathematical problems. In particular, *students will be expected to*:

2.1 conduct an investigation
2.2 use estimation and approximation
2.3 develop equations or use formulae
2.4 use flow charts
2.5 make lists and charts
2.6 look for patterns
2.7 work backward
2.8 break the problem into smaller parts
2.9 look for a simpler or related problem
2.10 make diagrams or models
2.11 use manipulatives
2.12 choose and sequence a series of mathematical operations
2.13 sketch the graph of a problem situation
2.14 establish procedures to gather and organize data
2.15 apply empirical or inductive processes
2.16 use geometric construction and measurement techniques
2.17 make and test a conjecture.

3. *Students will be expected to* develop a variety of skills that can be used to carry out the plan for the solution of a problem. In particular, *students will be expected to*:

3.1 apply selected strategies
3.2 present ideas clearly
3.3 document the solution process
3.4 use appropriate group behaviours
3.5 use calculators and computers
3.6 evaluate problem-solving strategies for effectiveness
3.7 alter or abandon non-productive strategies
3.8 search for additional information
3.9 ask questions
3.10 be open to inspirations, intuitions and "bright ideas".

4. *Students will be expected to* employ a variety of skills to help them look back over the solution of a problem. In particular, *students will be expected to*:

4.1 determine the reasonableness of an answer

4.2 explain the solution, in oral or written form
4.3 consider the possibility of additional solutions
4.4 search for other strategies and processes of solution
4.5 create and solve similar problems
4.6 note the characteristics that will be identifiable in similar problems
4.7 make a generalization
4.8 examine the assumption made and simplifications and modifications used for accuracy, effectiveness and efficiency.

NUMERATION

Numeration concepts and calculation skills are basic in order to address successfully any mathematical situation. Since it is the intent to integrate the development of these concepts and skills into the other expectations of this course, it is not expected that numeration will be taught as a topic on its own.

1. *Students will be expected to* demonstrate an understanding that computation requires skills in addition, subtraction, multiplication and division with whole numbers, integers and rational numbers and can be done mentally, with paper and pencil, and with electronic calculators, as appropriate to a particular situation.

Mental Computation

Students will be expected to:

1.1 add and subtract whole numbers, integers and rational numbers (limit: add three single-digit integers; subtract two single-digit integers; add and subtract two multiples of 5 and 10 up to 100; add and subtract fractions with common denominators; add and subtract tenths and hundredths written in decimal form)
1.2 multiply whole numbers, integers and rational numbers (limit: single-digit numbers, multiples of 5 and 10 multiplied by a single-digit multiplier; double any number up to 50; multiply whole numbers, integers and decimals by powers of 10)
1.3 square integers up to 10, and calculate square roots of integral perfect squares up to 100
1.4 divide whole numbers, integers and rational numbers (limit: divide integers to 100 that are perfect multiples of single-digit divisors; halve even integers to 50; divide whole numbers, integers and decimals by powers of 10)
1.5 determine whether a whole number or integer is divisible by 2, 3, 4, 5 or 10
1.6 transform fractions to percents (limit: denominators of 2, 3, 4, 5, 10, 100) and whole number percents
1.7 calculate the percent of given whole number quantities (limit: 1%, 10%, 25%, 50%, 100%, 200%)
1.8 recognize "families" of fractions (tenths, twelfths, sixteenths) and transform fractions within families to common denominators.

Paper and Pencil Computation

Students will be expected to:

1.9 add and subtract whole numbers, integers and rational numbers (limit: add three 2-digit integers; subtract 3-digit integers; add and subtract two fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 16; add three 2-digit decimals; subtract 2-digit decimals)

1.10 multiply whole numbers, integers and rational numbers (limit: 2-digit integers, 2-digit decimals, fractions with single-digit denominators and denominators that are multiples of 10)
1.11 divide whole numbers, integers and rational numbers (limit: 3-digit integers that are perfect multiples of single-digit divisors; halve even numbers up to 500)
1.12 calculate the percent of given quantities (limit: 5%, 15%, 25% and multiples of 10%)
1.13 calculate the value of a power (limit: whole number base < 10 and exponent of 2 or 3)
1.14 transform mixed numbers to decimals and percents (limit: denominators of 2, 3, 4, 5, 6, 8, 10).

Calculation with Calculators

Students will be expected to:

1.15 calculate the percent of given quantities
1.16 calculate the value of a power (limit: integral base and whole number exponent)
1.17 calculate the square root of any positive rational number
1.18 transform any rational number to decimal and percent form.

2. *Students will be expected to* demonstrate an understanding that rounding, estimation and approximation are fundamental to facility in calculation.

Students will be expected to:

2.1 round given values to a specified level of precision
2.2 round solutions to an appropriate level of precision
2.3 use estimation techniques to predict solutions to calculations.

3. *Students will be expected to* demonstrate an understanding that checking an answer for reasonableness and accuracy is a fundamental step in the calculation process and that the level of accuracy required is dependent upon the particular situation.

Students will be expected to:

3.1 use estimation techniques to check a calculation for reasonableness
3.2 determine if the accuracy of a calculated answer is adequate for a given situation.

GEOMETRY AND MEASUREMENT

Understanding of geometric concepts and facility with measurement skills are basic to many mathematical situations faced in life. Since it is the intent to integrate the development of these concepts and skills into the other expectations of this course, it is not expected that geometry and measurement will be taught as topics on their own.

1. *Students will be expected to* demonstrate an understanding that geometric shapes and solids have mathematical attributes.

Students will be expected to:

1.1 make scale drawings and models of geometric shapes and solids
1.2 use the geometric properties of angles and lines to determine the properties and measurements of shapes and solids.

2. *Students will be expected to* demonstrate an understanding that geometric shapes and solids can be measured directly and indirectly using various techniques, instruments and units, and that the accuracy of any measurement is dependent upon the instrument being used, the individual doing the measurement and the need for precision.

Students will be expected to:

2.1 measure length, angle, area, volume, capacity and mass, using appropriate instruments
2.2 determine approximate measurements from scale drawings or maps
2.3 determine the accuracy of a measurement based on the need and the instruments used
2.4 determine the proper precision for an approximated or ascertained measurement
2.5 use formulae for perimeter, area and volume to measure indirectly regular geometric shapes and solids
2.6 use procedures based on known formulae to measure indirectly irregular geometric shapes and solids.

WORK – INCOME

1. *Students will be expected to* demonstrate an understanding that pay received for work done can be calculated and that the deductions from gross pay can be determined.

Students will be expected to:

1.1 calculate gross wages based on a regular hourly rate and an overtime hourly rate as well as other pay methods, including weekly and monthly salaries, piecework, bonuses, commissions and combinations of methods
1.2 calculate net weekly, biweekly and monthly wages, considering deductions such as unemployment insurance, retirement pensions, Canada Pension Plan, medical insurance, disability insurance and income tax

1.2.1 compare the financial advantages between jobs in which the worker gets no benefits other than wages and those in which benefits are provided

1.3 calculate gross and net annual earnings, given various pay methods
1.4 calculate weekly, biweekly and monthly earnings, given annual earnings.

WORK – INCOME TAX

1. *Students will be expected to* demonstrate an understanding that income tax will be paid by all workers and that the amount paid will depend upon a number of factors.

Students will be expected to:

1.1 collect and interpret records of employment income
1.2 determine and calculate allowable deductions from income

1.2.1 determine the effect of discretionary deductions on total tax paid

1.3 complete an appropriate Revenue Canada taxation form.

BANKING – PERSONAL BANKING

1. *Students will be expected to* demonstrate an understanding that savings and chequing accounts with banks and other financial institutions are services that consumers can use to help manage their money.

   Students will be expected to:

   1.1 identify and compare types and purposes of accounts
   1.2 deposit and withdraw funds
   1.3 verify an account statement against records of deposit and withdrawal and reconcile chequing account statements

      1.3.1 compare the costs of various banking services, and determine the advantages and disadvantages of maintaining particular types of accounts

   1.4 calculate simple interest for periods involving days, months and years
   1.5 calculate compound interest

      1.5.1 use a calculator to calculate compound interest over a maximum of four compound interest periods
      1.5.2 use simple tables or a computer to calculate compound interest for more than four compound interest periods
      1.5.3 compare simple and compound investment earnings amongst various forms of savings plans including types of savings accounts, guaranteed investment certificates and other bank-centred savings plans.

BANKING – CONSUMER CREDIT

1. *Students will be expected to* demonstrate an understanding that borrowing money is a consumer activity in which the use of someone else's money is bought and that the price is interest paid on the principle borrowed.

   Students will be expected to:

   1.1 identify types and characteristics of loans such as consumer loans, car loans and consolidation loans

      1.1.1 compare actual costs of borrowing between different companies and different types of loans

   1.2 calculate the periodic payments for loans, using tables
   1.3 calculate the total amount to be repaid, including interest, given various types of loans and loan characteristics.

2. *Students will be expected to* demonstrate an understanding that credit cards provide consumers with instant loans.

   Students will be expected to:

   2.1 read, interpret and calculate the information on credit card sales, drafts and monthly statements
   2.2 calculate the interest charge due on a credit card balance

2.3 calculate the service charges associated with using credit cards, including membership charges, yearly fees and transaction fees
2.4 calculate the actual time required and total cost to pay off a credit card balance by making the minimum payment only.

TRANSPORTATION – PURCHASING A VEHICLE

1. *Students will be expected to* demonstrate an understanding of the costs associated with purchasing a motor vehicle.

Students will be expected to:

1.1 calculate the fair price of a vehicle given age, condition, odometer reading and options

1.1.1 determine the total costs expected (such as down payment, repairs, insurance, etc.) upon the purchase of a vehicle

1.2 determine the monthly payments for installment purchases

1.2.1 compare the costs of various payment options that may be available for the purchase or lease of a vehicle.

TRANSPORTATION – OPERATING A VEHICLE

1. *Students will be expected to* demonstrate an understanding of the costs associated with operating a motor vehicle.

Students will be expected to:

1.1 calculate the costs associated with owning a vehicle, including monthly payments, insurance, gasoline and maintenance costs
1.2 calculate the cost of vehicle insurance, given factors such as type and age of vehicle, gender, age and driving record of insured
1.3 calculate the fuel economy of a vehicle as rate of consumption per 100 km
1.4 calculate the cost of gasoline for travelling a given distance
1.5 determine the depreciation of a vehicle over time
1.6 calculate the total costs of owning and operating a vehicle over a period of time

1.6.1 examine the costs, advantages and disadvantages associated with alternatives to owning a motor vehicle, such as using public transit, taxicabs, riding a bicycle, etc.

TRANSPORTATION – TRAVELLING

1. *Students will be expected to* demonstrate an understanding of the costs associated with travelling.

Students will be expected to:

1.1 calculate the costs of accommodation and meals based on the location, length of trip, length of stay, type of meal plan and gratuities
1.2 estimate the costs of automobile travel, including fuel, maintenance, accommodation and meals en route, and compare the costs with other modes of travel

1.3 estimate the total distances travelled, using maps and distance charts
1.4 estimate miscellaneous costs such as entertainment, excursions, gratuities, health insurance and travel insurance
1.5 calculate the costs associated with travellers cheques and conversions amongst currencies
1.6 compare the costs of package vacations with the estimated costs of individually arranged vacations.

ACCOMMODATION – RENTING AND PURCHASING A HOME

1. *Students will be expected to* demonstrate an understanding that renting and purchasing a residence are two options with different responsibilities, advantages and costs.

Students will be expected to:

1.1 investigate the costs of renting, given various conditions such as location, type of building, size and amenities
1.2 estimate the monthly costs associated with renting a residence, including rent, parking, insurance and other fixed costs and utilities, and other variable costs
1.3 investigate the purchase price of a residence, given various conditions such as the type of housing, location, amenities and size
1.4 calculate the costs and fees associated with purchasing a residence
1.5 estimate and calculate the monthly costs associated with home ownership, including mortgage payments, taxes, utilities, insurance and maintenance
1.6 calculate the costs and fees associated with changing a residence, such as moving, utility hook-ups and security deposit
1.7 estimate and calculate the costs of furnishing and supplying a rental accommodation
1.8 compare the relative costs and advantages between owning and renting property.

ACCOMMODATION – MORTGAGE AND HOUSEHOLD INSURANCE

1. *Students will be expected to* demonstrate an understanding that a mortgage is a loan used to purchase a residence.

Students will be expected to:

1.1 define mortgage and distinguish between mortgage types and options
1.2 calculate mortgage payments, using amortization tables for various terms and conditions

1.2.1 compare the costs of mortgage payments, given various terms and payment options

1.3 calculate the total cost of purchasing real estate over the entire length of the amortization period

1.3.1 compare the total costs of several payment plans

1.4 estimate and calculate the regular payment made on a residence, if it is comprised of principle, interest and taxes.

2. *Students will be expected to* demonstrate an understanding that household insurance is protection purchased from a company to cover losses incurred to a residence or its contents.

Students will be expected to:

2.1 examine types of household insurance policies and the purposes and advantages of each
2.2 calculate the costs of insurance based on various factors including types of coverage, location, property value, type of construction, availability of fire protection, amount of deductible and limits of liability.

ACCOMMODATION – BUILDING, DECORATING AND FURNISHING

1. *Students will be expected to* demonstrate an understanding that the approximate cost of building a new house can be determined through estimations based on known measures and costs.

Students will be expected to:

1.1 make a scale drawing of a house and a lot
1.2 use the local building code ratios between the size of the foundation, house and lot to determine the allowable size of the house
1.3 estimate the total cost of building a house based on estimated costs per square metre

1.3.1 compare the costs of building a house, using various combinations and qualities of building materials.

2. *Students will be expected to* demonstrate an understanding that a residence can be represented by a scale drawing, which can then be measured and used for various purposes.

Students will be expected to:

2.1 make a scale drawing of a house, apartment or room to be decorated and furnished
2.2 calculate the surface areas (floors, ceilings, walls) to be decorated
2.3 calculate the costs of floor, window and wall coverings, and the total costs

2.3.1 perform an investigation to determine the costs of redecorating an entire residence

2.4 calculate the costs of furnishings and appliances.

COST OF INDEPENDENCE – BUDGETS AND GETTING VALUE FOR MONEY SPENT

1. *Students will be expected to* demonstrate an understanding that a personal budget is useful in order to maintain records of expenditure and to plan for the future.

Students will be expected to:

1.1 record estimated earnings and expenses
1.2 calculate individual expenses as percents of total expenses
1.3 design and balance a personal budget.

2. *Students will be expected to* demonstrate an understanding that consumers can obtain the best value for their money by the application of some wise spending practices.

   Students will be expected to:

   2.1 calculate and compare the unit costs of items
   2.2 calculate the sale price of an item, given the list or regular price and the discount
   2.3 calculate the rate of discount, given the regular and the sale prices
   2.4 calculate the regular price, given the sale price and the rate of discount
   2.5 calculate the sales tax on purchases.

COST OF INDEPENDENCE – LIFE AND HEALTH INSURANCE

1. *Students will be expected to* demonstrate an understanding that life insurance is a way to provide financial protection for dependents in case of death.

   Students will be expected to:

   1.1 identify, compare and discuss features of types of life insurance, such as term, whole-life, endowment and group
   1.2 calculate premiums for life insurance coverage, given factors such as amount of insurance, age, gender, health, employment, lifestyle and leisure activities
   1.3 identify and examine company projections of life insurance values, including dividends, over the life of a policy
   1.4 calculate the costs and benefits of health insurance, given various types of coverage
   1.5 calculate the costs and benefits of disability insurance.

MATHEMATICS PREPARATION 10

RATIONALE AND PHILOSOPHY

Rationale

Mathematics is a common human activity, increasing in importance in a rapidly advancing, technological society. A greater proficiency in using mathematics increases the opportunities available to individuals. Students need to become mathematically literate in order to explore problem-solving situations, accommodate changing conditions, and actively create new knowledge in striving for self-fulfillment.

A significant proportion of Grade 9 Mathematics students have marks that are close to, or slightly under, the pass mark of 50 per cent. These students are not sufficiently prepared to succeed in either Applied Mathematics 10 or Pure Mathematics 10 in senior high school. The alternative of Mathematics 14–24 does not address their needs. Mathematics Preparation 10 is a senior high school mathematics course designed to meet the needs of Grade 10 students who wish to enroll in either Applied Mathematics 10 or Pure Mathematics 10 but do not possess the prerequisite skills.

Students should not have to repeat outcomes for which they have already achieved an acceptable standard. Because of the sequential development of mathematical skills, some students will need to begin their study with Grade 7 or Grade 8 outcomes. Others may only require preparation in the Grade 9 Mathematics outcomes. Two course delivery options allow for this flexibility. Schools can offer, and students can choose, either 3 or 5 credits for Mathematics Preparation 10 depending on student needs.

Philosophy

A senior high school mathematics course that simply repeats the outcomes of Grade 9 Mathematics is not the optimal solution for Grade 10 students who have not met the standards of junior high school mathematics. These students require a course that will address their individual needs, with a focus on the mathematics skills and knowledge they lack from junior high school mathematics, or earlier. Students entering Grade 10 need a repertoire of fundamental mathematics skills and concepts. They also need to understand the ideas that make up those concepts and how they are related.

In Mathematics Preparation 10, students are required to demonstrate effective communication skills. When accomplishing outcomes, students will be expected to explain, to illustrate, to reason and to make connections. Multiple solution strategies to problems and problem contexts will be expected as students work through routine and nonroutine problems.

Technology is an integral part of Mathematics Preparation 10. Calculators and computer programs

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are used to enhance conceptual understanding and to facilitate higher order thinking through exploration, modelling and problem solving.

Students learn by attaching meaning to what they do, and they must be able to construct their own meaning of mathematics. This meaning is best developed when learners encounter mathematical experiences that proceed from the simple to the complex and from the concrete to the abstract. The use of manipulatives can address the diversity of learning styles and developmental stages of students and can enhance the formation of sound, transferable mathematical concepts. At all levels, students benefit from working with appropriate materials, tools and contexts when constructing personal meaning about new mathematical ideas. The learning environment should value and respect each student's way of thinking, so that the learner feels comfortable in taking intellectual risks, asking questions and posing conjectures.

STUDENT EXPECTATIONS

It is important for students to develop a positive attitude toward mathematics so they can become confident in their ability to use mathematics to solve real-life problems. Students should receive a level of mathematics education appropriate to their abilities and needs. At the completion of Mathematics Preparation 10, students must have the mathematical knowledge, skills and attitudes needed to allow them to succeed in senior high school mathematics and become mathematically literate adults.

Mathematics Preparation 10 incorporates the seven interrelated mathematical processes that are intended to permeate teaching and learning.

Students are expected to:

- *Communication [C]* – communicate mathematically
- *Connections [CN]* – connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines
- *Estimation and Mental Mathematics [E]* – use estimation and mental mathematics where appropriate
- *Problem Solving [PS]* – relate and apply new mathematical knowledge through problem solving
- *Reasoning [R]* – reason and justify their thinking
- *Technology [T]* – select and use appropriate technologies as tools to solve problems
- *Visualization [V]* – use visualization to assist in processing information, making connections and solving problems.

For more details on these mathematical processes, please refer to the *Alberta Program of Studies for K–9 Mathematics*, June 1996, pages 6–11.

INSTRUCTIONAL FOCUS

Students are curious, active learners who have individual interests, abilities and needs. They come to classrooms with different knowledge, life experiences and backgrounds that generate a range of attitudes about mathematics and life. Course delivery must be commensurate with differing abilities, interests and learning styles and be designed to enable students to have success in mathematics. The use of projects and technology should be emphasized to facilitate entrance into Applied Mathematics 10.

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Several additional considerations are important.

- The use of diagnostic strategies is encouraged to determine a student's area of strength and weakness. From this, individualized instruction should emerge.
- Concepts should be introduced, using manipulatives, and gradually developed from the concrete, to the pictorial, to the symbolic.
- Problem solving, reasoning and connections are vital to increasing mathematical power and must be integrated throughout the course. A minimum of half the available time within all strands could be dedicated to activities related to these processes. Activities that take place in the classroom should stem from a problem-solving approach with connections to the real world whenever possible.
- In mastering basic facts and arithmetic operations, the emphasis should be on developing understanding of the concept/processes, not on rote drill and practice. Although drill and practice needs to be part of a mathematics program, it should occur after students have developed an understanding of the concept/process and should not occur in isolation. If students understand the process, the amount of time needed for drill and practice is significantly reduced.
- There is to be a balance between estimation and mental mathematics, paper and pencil exercises and the appropriate use of technology, including calculators and computers.
- By decreasing emphasis on the size of numbers used in paper and pencil calculations, more time is available for concept development.
- There is an assumption made that all students have regular access to appropriate technology. For Mathematics Preparation 10, the scientific calculator and standard spreadsheet programs are appropriate.

STUDENT OUTCOMES

The content of Mathematics Preparation 10 is stated in terms of outcomes. These outcomes are measurable and identify what students are required to know and be able to do. The outcomes included, which have been derived from *The Common Curriculum Framework for K–12 Mathematics: Western Canadian Protocol for Collaboration in Basic Education*, 1995, are those that are judged to be essential for students to advance to Applied Mathematics 10 and Pure Mathematics 10.

Student outcomes are described in terms of:

- **General Outcomes**—general statements that identify what students are expected to know and be able to do upon completion of the course.
- **Specific Outcomes**—statements identifying the component knowledge, skills and attitudes of a general outcome.

Strands

The student outcomes are organized within four strands:

- **Number**
- **Patterns and Relations**
- **Shape and Space**
- **Statistics and Probability**.

The strands are the formal aspects of the discipline of mathematics that form the foundation of this course and act as connections across the grades. Four strands have been identified to reinforce the interrelationship of mathematical concepts and skills. These strands are split into substrands. However, any such grouping into strands and substrands is for organizational purposes only, and does not reflect the connections among the strands and the underlying themes running throughout all of mathematics.

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Horizontal Correlation

The general outcomes from Mathematics Preparation 10 have been correlated to the corresponding general outcomes in Grade 6 through Grade 9 and to those in Applied Mathematics 10 and Pure Mathematics 10. These are shown in the chart below.

GENERAL OUTCOMES—Number Strand

Substrand	Grade 6	Grade 7	Grade 8
Number Concepts *Students will:* • use numbers to describe quantities • represent numbers in multiple ways.	Develop a number sense for decimals and common fractions, explore integers, and show number sense for whole numbers.	Demonstrate a number sense for decimals and integers, including whole numbers.	Demonstrate a number sense for rational numbers, including common fractions, integers and whole numbers.
Number Operations *Students will:* • demonstrate an understanding of and proficiency with calculations • decide which arithmetic operation or operations can be used to solve a problem, and then solve the problem.	Apply arithmetic operations on whole numbers and decimals in solving problems.	Apply arithmetic operations on decimals and integers, and illustrate their use in solving problems. Illustrate the use of rates, ratios, percentages and decimals in solving problems.	Apply arithmetic operations on rational numbers to solve problems. Apply the concepts of rate, ratio, percentage and proportion to solve problems in meaningful contexts.

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Grade 9	Mathematics Preparation 10	Applied Mathematics 10/ Pure Mathematics 10
Explain and illustrate the structure and the interrelationship of the sets of numbers within the rational number system. Develop a number sense of powers with integral exponents and rational bases.	**Demonstrate a knowledge of the interrelationship of the sets of numbers within the real number system.** **Develop a number sense of powers with integral exponents and rational bases.**	Analyze the numerical data in a table for trends, patterns and interrelationships. [Applied Mathematics 10 and Pure Mathematics 10] Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system. [Applied Mathematics 10 and Pure Mathematics 10]
Use a scientific calculator or a computer to solve problems involving rational numbers. Explain how exponents can be used to bring meaning to large and small numbers, and use calculators or computers to perform calculations involving these numbers.	**Use a scientific calculator to solve problems involving real numbers.** **Demonstrate an understanding of and proficiency with calculations on rational numbers.** **Decide which arithmetic operations can be used to solve a problem and then solve the problem.** **Illustrate and apply the concepts of rates, ratios, percentages and proportions to solve problems.** **Apply exponent laws to solve problems.**	Use basic arithmetic operations on real numbers to solve problems. [Applied Mathematics 10 and Pure Mathematics 10] Describe and apply arithmetic operations on tables to solve problems, using technology as required. [Applied Mathematics 10 and Pure Mathematics 10] Use exact values, arithmetic operations and algebraic operations on real numbers to solve problems. [Pure Mathematics 10]

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GENERAL OUTCOMES—Patterns and Relations Strand

Substrand	Grade 6	Grade 7	Grade 8
Patterns *Students will:* • use patterns to describe the world and to solve problems.	Use relationships to summarize, generalize and extend patterns, including those found in music and art.	Express patterns, including those used in business and industry, in terms of variables, and use expressions containing variables to make predictions.	Use patterns, variables and expressions, together with their graphs, to solve problems.
Variables and Equations *Students will:* • represent algebraic expressions in multiple ways.	Use informal and concrete representations of equality and operations on equality to solve problems.	Use variables and equations to express, summarize and apply relationships as problem-solving tools in a restricted range of contexts.	Solve and verify one-step and two-step linear equations with rational number solutions.

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Grade 9	Mathematics Preparation 10	Applied Mathematics 10/ Pure Mathematics 10
Generalize, design and justify mathematical procedures, using appropriate patterns, models and technology.	**Generalize, design and justify mathematical procedures, using appropriate patterns and technology.**	Generate and analyze number patterns. [Pure Mathematics 10]
Solve and verify linear equations and inequalities in one variable. Generalize arithmetic operations from the set of rational numbers to the set of polynomials.	**Solve and verify linear equations and inequalities in one variable.** **Generalize arithmetic operations from the set of rational numbers to the set of polynomials.**	Generalize operations on polynomials to include rational expressions. [Pure Mathematics 10]

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GENERAL OUTCOMES—Shape and Space Strand

Substrand	Grade 6	Grade 7	Grade 8
Measurement *Students will:* • describe and compare everyday phenomena, using either direct or indirect measurement.	Solve problems involving perimeter, area, surface area, volume and angle measurement.	Solve problems involving the properties of circles and their connections with angles and time zones.	Apply indirect measurement procedures to solve problems. Generalize measurement patterns and procedures, and solve problems involving area, perimeter, surface area and volume.
3-D Objects and 2-D Shapes *Students will:* • describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	Use visualization and symmetry to solve problems involving classification and sketching.	Link angle measures to the properties of parallel lines.	Link angle measures and the properties of parallel lines to the classification and properties of quadrilaterals.
Transformations *Students will:* • perform, analyze and create transformations.	Create patterns and designs that incorporate symmetry, tessellations, translations and reflections.	Create and analyze patterns and designs, using congruence, symmetry, translation, rotation and reflection.	Create and analyze design problems and architectural patterns, using the properties of scaling, proportion and networks.

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Grade 9	Mathematics Preparation 10	Applied Mathematics 10/ Pure Mathematics 10
Use trigonometric ratios to solve problems involving a right triangle. Describe the effects of dimension changes in related 2-D shapes and 3-D objects in solving problems involving area, perimeter, surface area and volume.	**Solve problems, using right triangles.** **Solve problems involving perimeter, area, surface area and volume.**	Demonstrate an understanding of scale factors and their interrelationship with the dimensions of similar shapes and objects. [Applied Mathematics 10] Solve problems involving triangles, including those found in 3-D and 2-D applications. [Applied Mathematics 10 and Pure Mathematics 10] Use measuring devices to make estimates and to perform calculations in solving problems. [Applied Mathematics 10]
Specify conditions under which triangles may be similar or congruent, and use these conditions to solve problems. Use spatial problem solving in building, describing and analyzing geometric shapes.	**Specify conditions under which triangles may be similar, and use these conditions to solve problems.**	Solve coordinate geometry problems involving lines and line segments. [Applied Mathematics 10 and Pure Mathematics 10]
Apply coordinate geometry and pattern recognition to predict the effects of translations, rotations, reflections and dilatations on 1-D lines and 2-D shapes.	**Create and analyze patterns and designs, using symmetry, translation, rotation and reflection.**	

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GENERAL OUTCOMES—Statistics and Probability Strand

Substrand	Grade 6	Grade 7	Grade 8
Data Analysis *Students will:* • collect, display and analyze data to make predictions about a population.	Develop and implement a plan for the collection, display and analysis of data gathered from appropriate samples.	Develop and implement a plan for the collection, display and analysis of data, using measures of variability and central tendency.	Develop and implement a plan for the collection, display and analysis of data, using technology, as required. Evaluate and use measures of central tendency and variability.

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Grade 9	Mathematics Preparation 10	Applied Mathematics 10/ Pure Mathematics 10
Collect and analyze experimental results expressed in two variables, using technology, as required.	**Develop and implement a plan for the display and analysis of data.** **Analyze experimental results expressed in two variables.**	Implement and analyze sampling procedures, and draw appropriate inferences from the data collected. [Pure Mathematics 10] Apply line-fitting and correlation techniques to analyze experimental results. [Applied Mathematics 10]

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Coding of Outcomes for Mathematics Preparation 10

- The specific outcomes for Mathematics Preparation 10 have been numbered sequentially within each strand.
- Each specific outcome has been cross-referenced to the *Alberta Program of Studies for K–9 Mathematics*, June 1996. For example, (8–7) refers to Grade 8, Specific Outcome 7, in the same strand as the stated outcome. This cross-referencing will allow teachers to refer to the *Alberta Program of Studies for K–9 Mathematics* for illustrative examples of the specific outcomes.
- The mathematical processes to be addressed in conjunction with the specific outcomes are included after each outcome. For example, [C, R, V] means the students should use the mathematical processes of communication, reasoning and visualization in addressing this specific outcome.

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Strand: Number (Number Concepts)

Students will:

- use numbers to describe quantities
- represent numbers in multiple ways.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcomes	Specific Outcomes
Demonstrate a knowledge of the interrelationship of the sets of numbers within the real number system.	1. Compare and order integers. [R, V] (7–12) 2. Find and be able to model an understanding of common multiples, common factors, lowest common multiple and greatest common factor as they apply to whole numbers. [C, PS, R, V] (6–4) 3. Demonstrate and explain the meaning of proper and improper fractions. [C, R, V] (6–9) 4. Distinguish between exact values and decimal approximations of square roots and cube roots. [E, T] (8–8) 5. Differentiate between principal square root and positive and negative square roots of a number; give examples where answers would involve the positive (principal) square root or both positive and negative square roots of a number. [C, CN, PS, R] (9–3)
Develop a number sense of powers with integral exponents and rational bases.	6. Recognize and illustrate the meaning of a power, base, coefficient and exponent, including rational numbers or variables as bases or coefficients. [R, V] (9–4) 7. Explain and apply the exponent laws for powers with integral exponents. $x^m \bullet x^n = x^{m+n}$ $x^m \div x^n = x^{m-n}$ $(x^m)^n = x^{mn}$ $(xy)^m = x^m y^m$ $\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}, y \neq 0$ $x^0 = 1, x \neq 0$ $x^{-n} = \frac{1}{x^n}, x \neq 0$ [PS, R] (9–5)

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Strand: Number (Number Operations)

Students will:

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem, and then solve the problem.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcomes	Specific Outcomes
Use a scientific calculator to solve problems involving real numbers.	8. Document and explain the calculator keying sequences used to perform: • square roots, cube roots • exponents • scientific notation • sine, cosine, tangent • integers. [PS, R, T] (9–10)
Demonstrate an understanding of and proficiency with calculations on rational numbers. **AND** Decide which arithmetic operations can be used to solve a problem and then solve the problem.	9. Perform arithmetic operations with integers concretely, pictorially and symbolically. [PS, V] (7–16) 10. Illustrate and explain the order of operations. [PS, T, V] (7–17) 11. Add, subtract, multiply and divide fractions concretely, pictorially and symbolically. [E, PS, V] (8–9) 12. Convert among fractions, decimals and percents to solve problems. [E, PS, R, T] (8–12) 13. Estimate and calculate operations on rational numbers. [E, PS, T] (8–10) 14. Solve problems involving multiple steps and multiple operations, and accept that other methods may be equally valid. [PS] (5–13) 15. Use a variety of methods to solve problems, such as drawing a diagram, making a table, guessing and testing, using objects to model, making it simpler, looking for a pattern, using logical reasoning and working backward. [PS, R, T, V] (6–14)

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Strand: Number (Number Operations)

Students will:

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem, and then solve the problem.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcomes	Specific Outcomes
Illustrate and apply the concepts of rates, ratios, percentages and proportions to solve problems.	16. Understand the meaning of rate, ratio, percentage and proportion; and apply these concepts to solve problems. [E, PS, T] (8–12) 17. Express rates and ratios in equivalent forms. [CN, PS, R] (8–15)
Apply exponent laws to solve problems.	18. Use exponent laws to evaluate expressions with numerical bases. [PS, R, T] (9–9) 19. Understand and use the exponent laws to simplify expressions with variables as bases, and use substitution to calculate a numerical value. [PS, R, T] (9–9)

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Strand: Patterns and Relations (Patterns)
Students will:
- use patterns to describe the world and to solve problems.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcome	Specific Outcomes
Generalize, design and justify mathematical procedures, using appropriate patterns and technology.	1. Generalize a pattern arising from a problem-solving context, using mathematical expressions and equations, and verify by substitution. [C, CN, PS, R] (8–1, 9–1) 2. Given a first-degree equation, substitute numbers for variables and graph and analyze the relation. [C, PS, R, V] (8–2) 3. Translate between an oral or written expression and an equivalent algebraic expression. [C, CN] (8–3, 9–8) 4. Write equivalent forms of algebraic expressions, or equations, with integral coefficients. [C, CN, R] (9–3)

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Strand: Patterns and Relations (Variables and Equations)

Students will:

- represent algebraic expressions in multiple ways.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcome	Specific Outcomes
Generalize arithmetic operations from the set of rational numbers to the set of polynomials.	5. Identify constant terms, coefficients and variables in polynomial expressions. [C] (9–7) 6. Evaluate polynomial expressions, given the values of the variables. [E] (9–8) 7. Represent and justify the addition and subtraction of polynomial expressions, using concrete materials and diagrams. [C, R, V] (9–9) 8. Perform the operations of addition and subtraction on polynomial expressions. [R] (9–10) 9. Represent multiplication, division and factoring of monomials, binomials and trinomials of the form $x^2 + bx + c$, using concrete materials and diagrams. [R, V] (9–11) 10. Find the product of: • two monomials • a monomial and a polynomial • two binomials. [R] (9–12) 11. Determine equivalent forms of algebraic expressions by identifying common factors. [PS, R] (9–13) 12. Factor trinomials of the form $ax^2 + bx + c$, where $a = 1$, or of the form $ax^2 + abx + ac$. [PS, R] (9–13) 13. Factor polynomials of the form $A^2 - B^2$, where A and B are both monomial expressions. [PS, R] 14. Find the quotient when a polynomial is divided by a monomial. [PS, R] (9–14)

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Strand: Patterns and Relations (Variables and Equations)

Students will:

- represent algebraic expressions in multiple ways.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcome	Specific Outcomes
Solve and verify linear equations and inequalities in one variable.	15. Illustrate the solution process for a one-step, single variable, first-degree equation, using concrete materials or diagrams. • $x + a = b$ • $x - a = b$ • $ax = b$ • $\frac{x}{a} = b$ [CN, PS, V] (7–7) 16. Solve and verify, using a variety of techniques, one-step linear equations of the form: $x + a = b$ $\frac{x}{a} = b$ $ax = b$ where a and b are integers. [PS, R] (7–8) 17. Illustrate the solution process for a two-step, single variable, first-degree equation, using concrete materials or diagrams. [CN, PS, V] (8–4) 18. Solve and verify one- and two-step first-degree equations of the form: • $\frac{x}{a} + b = c$ • $ax + b = c$ where a, b and c are integers. [PS, V] (8–5) 19. Solve and verify first-degree, single variable equations of the form: • $ax = b + cx$ • $a(x + b) = c$ • $ax + b = cx + d$ • $a(bx + c) = d(ex + f)$ • $\frac{a}{x} = b$ where a, b, c, d, e and f are rational numbers (with a focus on integers); and use equations of this type to model and solve problem situations. [C, PS, V] (9–5)

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Strand: Shape and Space (Measurement)

Students will:

- describe and compare everyday phenomena, using either direct or indirect measurement.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcomes	Specific Outcomes
Solve problems involving perimeter, area, surface area and volume.	1. Estimate, measure and calculate the surface area and volume of any right prism, cylinder, cone or pyramid. [E, PS, R, T] (6–4, 7–2, 8–4)
	2. Demonstrate concretely, pictorially and symbolically that many rectangles are possible for a given perimeter or a given area. [CN, R] (6–7)
Solve problems, using right triangles.	3. Use the Pythagorean relationship to calculate the measure of the third side of a right triangle, given the other two sides, in 2-D applications. [PS] (8–2)
	4. Estimate, measure and classify angles as: • acute • obtuse • right • straight • reflex. [E] (6–10)
	5. Explain the meaning of sine, cosine and tangent ratios in right triangles. [C, R] (9–1)
	6. Calculate an unknown side or an unknown angle in a right triangle, using trigonometric ratios. [PS, T, V] (9–3)
	7. Model and then solve given problem situations involving only one right triangle. [PS, T, V] (9–4)

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Strand: Shape and Space (3-D Objects and 2-D Shapes)

Students will:

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcome	Specific Outcome
Specify conditions under which triangles may be similar, and use these conditions to solve problems.	8. Recognize when, and explain why, two triangles are similar; and use the properties of similar triangles to solve problems. [C, PS, R, T] (9–8)

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Strand: Shape and Space (Transformations)

Students will:

- perform, analyze and create transformations.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcome	Specific Outcomes
Create and analyze patterns and designs, using symmetry, translation, rotation and reflection.	9. Draw designs, using ordered pairs, in all four quadrants of the coordinate grid. [PS, V] (7–13) 10. Draw and interpret scale diagrams, including: • enlargements • reductions. [PS, T, V] (8–11)

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Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General Outcomes	Specific Outcomes
Develop and implement a plan for the display and analysis of data. Analyze experimental results expressed in two variables.	1. Read and interpret graphs that are provided. [C, E, PS, R] (6–7) 2. Create scatterplots for discrete and continuous variables. [C, V] (9–2) 3. Interpret a scatterplot to determine if there is an apparent relationship. [E, R] (9–3) 4. Determine, by inspection, the line of best fit from a scatterplot for an apparent linear relationship. [E, PS] (9–4) 5. Draw and justify conclusions from the line of best fit, by: • interpolation • extrapolation. [C, R] (9–5)

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NATIVE LANGUAGES

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★ Blackfoot Language and Culture 10–20–30

★ Cree Language and Culture 10–20–30

★ For current information on basic learning resources, consult the Learning Resources Distributing Centre *Buyers Guide*.

BLACKFOOT LANGUAGE AND CULTURE 10–20–30

A. PROGRAM RATIONALE AND PHILOSOPHY

Language mirrors the culture of those who speak it. Language is not just a component of the culture; it is the channel through which all parts of a culture are expressed.

The Blackfoot people believed that the Creator gave them the Blackfoot language. Therefore, the Blackfoot language was to be treated and used with the utmost respect. The Blackfoot language has been the foundation of the culture and society for past and present generations, and it should remain so for all future generations.

The Blackfoot people aim at achieving excellence in the education of each member of the tribe—a total learning experience that embraces spiritual, mental, physical and cultural aspects. Since education is a vehicle for transmitting knowledge and the underlying values of a culture, education for Blackfoot children should stress the Blackfoot language, culture and values.

The inclusion of second languages in school programs is no longer an issue in the majority of countries around the world. Many leaders, educators and interested people have come to realize that international cooperation can come about only when people in each nation have developed an intimate knowledge and understanding of the other's language and culture.

Including the Blackfoot language in school programs is the wish of the Assembly of First Nations' leaders. They have stated that Native children must have the opportunity to learn their language, history and culture in the classroom. The Blackfoot wish to restore, preserve, protect and promote their language and cultural traditions, literature, histories, beliefs, values and identity by using, practising and developing their mother tongue. They desire to see each young person become competent and proficient in speaking, reading and writing their native tongue.

The Blackfoot people, Elders and parents now want their children and grandchildren to learn the Blackfoot language. Young parents express a strong desire to learn Blackfoot in order to teach their children the language. Elders relate their stories and advice in the Blackfoot language. The Elders express their concern that the young people no longer understand and speak the Blackfoot language.

The Blackfoot language has been introduced in southern Alberta school systems, mainly in oral form. However, there has been a need for a curricular program for Blackfoot language teachers and school administrators. Blackfoot 10–20–30 will facilitate learning experiences for Native students and help them increase their knowledge of their own language, beliefs and culture. For non-Native learners, the program will provide awareness and understanding of another culture. Study of the Blackfoot language will help students become critical thinkers by providing them with a framework for

skill development. As a result of the study of the language, Native and non-Native students will realize the important role that Native people have played in the history of Alberta and of the Canadian nation.

Studying a second language provides a new experience. It enlarges the students' horizons by introducing a new way of communicating and a new cultural pattern. Students increase their ability to understand a second language through enjoyable and functional interaction with people of another culture. They develop a new understanding of language by studying the structure of language. They also gain a new perspective on their first language and increase their vocabulary and self-expression. They expand and deepen their knowledge of another community, which often leads to a clearer view of their own culture and an adjustment to the concept of differences between cultures.

Teaching the Blackfoot language will help to prevent its extinction. In summary, Blackfoot 10–20–30 should serve as a means to fulfill the expressed needs of the Blackfoot people while promoting intercultural communication.

The purpose of this program is to outline a curriculum that will help students develop the skills necessary to communicate in the Blackfoot language. Language is acquired through interaction with others. The program allows the students to meet and use language in a variety of social and cultural situations. The program teaches knowledge, skills and attitudes in meaningful contexts. The students' contacts with people, things, events and ideas of the world around them serve as the base for language development. Blackfoot 10–20–30 covers content areas in human relationships, relationships to the natural environment and cultural lifestyles. Blackfoot 10 deals with aspects of the students' immediate environment; Blackfoot 20 assists them to develop an understanding of community relationships; and Blackfoot 30 expands their world view.

Because the students will have had varying degrees of exposure to Blackfoot culture, the teacher is encouraged to choose experiences for language development that reflect the interests and needs of the students as well as their communities.

The cultural component thread that runs throughout the three levels develops the students' self-esteem; opens doors to job opportunities requiring a knowledge of a Native language; and builds their tolerance and understanding for other Native and non-Native cultures. It helps the students to know and understand the values, beliefs, customs and mores of the Blackfoot culture from a contemporary and a historical perspective. It prepares the students to communicate with the older generations of the Blackfoot people—the parents and the Elders. By knowing the language and using it, the students help to keep the language and the culture alive.

A reading and writing component has been included in the program for two reasons. First, it is hoped that it can be used as a tool to reinforce the oral language skills of the students; second, it is hoped that written Blackfoot will increase the functional uses of the Blackfoot language in the future. This component is based on the recent works of linguists working with the language.

Blackfoot 10–20–30 leads the students through stages of linguistic development. The program follows the general principles of language learning by introducing skills and concepts of increasing complexity as students move from level 10 to level 30. Through listening and reading, students build an increasing repertoire of knowledge and receive input from others. Full comprehension, however, involves generating factual, inferential, critical and creative ideas. By developing skills for locating, selecting, organizing and sequencing ideas in oral and written language, students come to understand how the language functions. Language competence is the expected end product of Blackfoot 10–20–30. Therefore, the program helps students use words, sentence patterns, intonation patterns and social conventions that characterize the Blackfoot language in a social and cultural context.

B. GENERAL LEARNER EXPECTATIONS

The general learner expectations describe, in broad terms, what knowledge, skills and attitudes students should be able to demonstrate as a result of their learning experiences in the Blackfoot language and culture program.

The general learner expectations for this program are:

1. Listening and Speaking Skills and Attitudes

   Students will be able to comprehend the spoken communications of others and express themselves orally while interacting in situations where the Blackfoot language is used.

2. Reading and Writing Skills and Attitudes

   Students will be able to comprehend written language and express themselves in writing in situations where the Blackfoot language is used.

3. Linguistic Code

   Students will be able to apply the Blackfoot linguistic code with increasing accuracy as they use the Blackfoot language to communicate (listen, speak, read and write).

4. Learning Strategies

   Students will be able to use basic learning strategies to derive or communicate meaning, in the Blackfoot language.

5. Experience Using the Language

   Students will demonstrate an ability to use language in the context of experiences taken from their everyday lives, as well as from the Blackfoot culture.

6. Cultural Attitudes

   Students will demonstrate a positive self-concept, confidence, pride and self-esteem as a result of knowing and experiencing the Blackfoot language and culture.

C. SPECIFIC LEARNER EXPECTATIONS

The specific learner expectations expand on each of the general learner expectations. They are explicit statements about what students are expected to achieve. The expectations serve as benchmarks to indicate stages in students' development of their language and cultural proficiency.

The expectations move the students from concrete and familiar knowledge to more abstract and applied knowledge. They also move the students from the skills required to interact in controlled or predictable situations to those requiring more spontaneous and creative interaction.

REQUIRED AND ELECTIVE COMPONENTS

The instructional time for the Blackfoot 10–20–30 program is to be allocated as follows:

- 80% required component
- 20% elective component.

The **required component** of the program consists of all the language and cultural expectations outlined in the program statements.

The **elective component** of the program consists of language and cultural expectations that allow the teacher to:

- remediate or reinforce skills, concepts and attitudes from the required component
- extend or enrich the program to meet particular student or Blackfoot community interests
- meet the instructional needs of minority students, who may be either students whose first language is Blackfoot or students who may be learning Blackfoot as a second language.

GENERAL LEARNER EXPECTATION 1: LISTENING AND SPEAKING SKILLS AND ATTITUDES

Students will be able to comprehend the spoken communications of others and express themselves orally while interacting in situations where the Blackfoot language is used.

Blackfoot 10 Listening and Speaking	Blackfoot 20 Listening and Speaking	Blackfoot 30 Listening and Speaking
Students will:	*Students will:*	*Students will:*
1.1 be able to comprehend and speak in language experiences where: • the topic is familiar and interesting to them • actions and language are predictable, repetitive or structured • body and verbal language are informal • the audience is sympathetic, and speakers use simple sentences, clearly and at normal speed • the Blackfoot cultural content is related to the Blackfoot 10 program.	1.1 be able to comprehend and speak in language experiences where: • the topic is familiar to them • actions and language are predictable and/or routine • information and interaction is less structured than in Blackfoot 10 • body and verbal language are informal • the audience is sympathetic, and speakers use simple sentences, clearly and at normal speed • the Blackfoot cultural content and activities are related to the Blackfoot 20 program.	1.1 be able to comprehend and speak in language experiences where: • the topic is less controlled than in Blackfoot 10 and 20 • actions and language are predictable, but less structured than in Blackfoot 10 and 20 • Blackfoot cultural content and activities are related to the Blackfoot 30 program • language is formal and/or informal (speeches, counselling, prayers) • the audience is neutral, speaking in a way that fits the context.
1.2 be able to communicate in language experiences by: • comprehending and speaking intelligible words, phrases, expressions and simple sentences appropriate to the social and cultural context • paying more attention to meaning than to accuracy of form • displaying poise and animation • using appropriate body language.	1.2 be able to communicate in language experiences by: • comprehending and speaking intelligible words, phrases, expressions and simple sentences appropriate to the social and cultural context • paying attention to meaning, and beginning to pay increasing attention to accuracy of form • displaying poise and animation • using appropriate body language.	1.2 be able to communicate in language experiences by: • comprehending and speaking intelligible expressions and complex sentences appropriate to the social and cultural context • paying increasing attention to accuracy of form • displaying poise and animation • using appropriate body language.

Blackfoot 10 Listening and Speaking	Blackfoot 20 Listening and Speaking	Blackfoot 30 Listening and Speaking
1.3 be able to comprehend and speak in different situations to achieve the following communicative purposes: • asking questions and giving simple answers: who, what, when, where, why • understanding and providing descriptions • understanding and giving commands • understanding and expressing simple feelings and attitudes.	1.3 be able to comprehend and speak in different situations to achieve the following communicative purposes: • requesting and reporting information • providing simple explanations • initiating discussions • meeting routine needs • engaging in simple social conversations.	1.3 be able to comprehend and speak in different situations to achieve the following communicative purposes: • discussing and debating • solving problems • exploring and critically evaluating ideas • gaining and expressing insights • brainstorming • understanding and expressing more subtle and complex feelings and attitudes than in Blackfoot 10 and 20.
1.4 understand and produce simple oral text on familiar topics in the form of narratives, legends and myths, short stories, anecdotes, prayers, songs and poetry.	1.4 understand and produce simple oral text on somewhat unfamiliar topics in the form of legends and myths, short stories, anecdotes, narratives, prayers, songs, poetry, Blackfoot radio and other media forms.	1.4 understand and produce oral text on topics that are new to them in the form of legends and myths, short stories, anecdotes, narratives, prayers, songs, poetry, Blackfoot radio and other media forms, and Elders' talk (history, legends, counsel).
1.5 be able to tolerate some ambiguity or uncertainty, in their own minds and in the minds of others, while taking part in language experiences appropriate for Blackfoot 10.	1.5 be able to tolerate some ambiguity or uncertainty, in their own minds and in the minds of others, while taking part in language experiences appropriate for Blackfoot 20.	1.5 be able to tolerate some ambiguity or uncertainty, in their own minds and in the minds of others, while taking part in language experiences appropriate for Blackfoot 30.
1.6 take risks in attempting to communicate with others.	1.6 take risks in attempting to communicate with others.	1.6 take risks in attempting to communicate with others.
1.7 take risks in attempting to understand others.	1.7 take risks in attempting to understand others.	1.7 take risks in attempting to understand others.
1.8 demonstrate awareness of and respect for the courtesies of interaction in language experiences appropriate to Blackfoot 10.	1.8 practise the courtesies of interaction in language experiences appropriate to Blackfoot 20.	1.8 practise the courtesies of interaction in language experiences appropriate to Blackfoot 30.
		1.9 demonstrate awareness and appreciation of the Blackfoot oral tradition and effective Blackfoot oral communication styles.

GENERAL LEARNER EXPECTATION 2: READING AND WRITING SKILLS AND ATTITUDES

Students will be able to comprehend written language and express themselves in writing in situations where the Blackfoot language is used.

Blackfoot 10 Reading and Writing	Blackfoot 20 Reading and Writing	Blackfoot 30 Reading and Writing
Students will:	*Students will:*	*Students will:*
2.1 associate Blackfoot sounds with standard Roman orthography when using words, phrases and simple sentences (vowels, consonants, syllables, intonation, glottal stops).	2.1 read Blackfoot language written in standard Roman orthography with increasingly accurate comprehension and increasing speed.	2.1 read Blackfoot language written in standard Roman orthography with increasing accuracy of comprehension and increasing speed.
2.2 understand simple written texts on familiar topics, in the form of narratives, legends and myths, short stories, prayers, songs and poetry.	2.2 understand simple written texts on somewhat unfamiliar topics, in the form of narratives, legends and myths, short stories, prayers, songs, poetry and various Blackfoot print media.	2.2 understand written texts on topics that are new to them, in the form of narratives, legends and myths, short stories, prayers, songs, poetry, Blackfoot radio and other media forms, and written forms of Elders' talk (history, legends, counsel).
2.3 accurately write Blackfoot sounds in standard Roman orthography, when using words, phrases and simple sentences.	2.3 write simple sentences and short paragraphs in Blackfoot, using standard Roman orthography with increasing speed and accuracy.	2.3 write in Blackfoot, using standard Roman orthography with increasing speed and accuracy.
2.4 write letters, poetry, songs, prayers, short stories, narratives and descriptions on familiar topics, using short, simple sentences.	2.4 write texts of increasing complexity, length and content in the form of letters, poetry, songs, prayers, short stories, narratives, descriptions, family histories, autobiographies and simple reports.	2.4 write texts of increasing complexity in the form of letters, poetry, songs, prayers, short stories, narratives, descriptions, oral histories, transcriptions of legends and oral prose, biographies, reports and short essays.
2.5 tolerate some ambiguity or uncertainty while reading text appropriate for Blackfoot 10.	2.5 tolerate some ambiguity or uncertainty while reading text appropriate for Blackfoot 20.	2.5 tolerate some ambiguity or uncertainty while reading text appropriate for Blackfoot 30.
2.6 take risks in attempting to comprehend written text appropriate to Blackfoot 10.	2.6 take risks in attempting to comprehend written text appropriate to Blackfoot 20.	2.6 take risks in attempting to comprehend written text appropriate to Blackfoot 30.
2.7 take risks in attempting to write text appropriate to Blackfoot 10.	2.7 take risks in attempting to write text appropriate to Blackfoot 20.	2.7 take risks in attempting to write text appropriate to Blackfoot 30.

GENERAL LEARNER EXPECTATION 3: LINGUISTIC CODE

Students will be able to apply the Blackfoot linguistic code with increasing accuracy as they use the Blackfoot language to communicate (listen, speak, read and write). (The teacher will aim for initial broad exposure to grammar and work, over time, toward mastery.)

Blackfoot 10 Linguistic Code	Blackfoot 20 Linguistic Code	Blackfoot 30 Linguistic Code
Students will be able to:	*Students will be able to:*	*Students will be able to:*
3.1 Phonology • use their knowledge of Blackfoot phonology to comprehend and express themselves with increasing accuracy in language experiences.	3.1 Phonology • use their knowledge of Blackfoot phonology to comprehend and express themselves with increasing accuracy in language experiences.	3.1 Phonology • use their knowledge of Blackfoot phonology to comprehend and express themselves with increasing accuracy in language experiences.
3.2 Lexicon • use their knowledge of the Blackfoot lexicon to comprehend and express themselves with increasing accuracy in language experiences appropriate to Blackfoot 10: – content words from language experiences – notions and functions appropriate to language experiences.	3.2 Lexicon • use their knowledge of the Blackfoot lexicon to comprehend and express themselves with increasing accuracy in language experiences appropriate to Blackfoot 20: – content words from language experiences – syntax – semantics – notions and functions appropriate to language experiences.	3.2 Lexicon • use their knowledge of the Blackfoot lexicon to comprehend and express themselves with increasing accuracy in language experiences appropriate to Blackfoot 30: – content words from language experiences – syntax – semantics – notions and functions appropriate to language experiences.
3.3 Grammar • use their knowledge of Blackfoot grammar to comprehend and express themselves with increasing accuracy in language experiences: – gender: animate/inanimate – nouns: plural, animate/inanimate – verb tenses: present/ past/future – affirmative/negative	3.3 Grammar • use their knowledge of Blackfoot grammar to comprehend and express themselves with increasing accuracy in language experiences: – verb tenses: perfect – affirmative/negative – verb phrases – adverbs – adjectives, prepositions, comparison, indefinite and reflexive pronouns, case forms, modals.	3.3 Grammar • use their knowledge of Blackfoot grammar to comprehend and express themselves with increasing accuracy in language experiences: – progressive verb tense – complex adverbs – complex question forms – conjunctions – verb phrases and clauses – verbs: imperative, indicative and subjunctive.

Blackfoot 10 Linguistic Code	Blackfoot 20 Linguistic Code	Blackfoot 30 Linguistic Code
3.3 Grammar (continued) – pronouns: demonstrative, relative, interrogative, objective and possessive case, singular and plural personal pronouns.		
	3.4 Morphology • use their knowledge of Blackfoot morphology to comprehend and express themselves with increasing accuracy in language experiences: – inflection – derivatives.	3.4 Morphology • use their knowledge of Blackfoot morphology to comprehend and express themselves with increasing accuracy in language experiences: – inflection – derivatives.

GENERAL LEARNER EXPECTATION 4: LEARNING STRATEGIES

Students will be able to use basic learning strategies to derive or communicate meaning, in the Blackfoot language.

Blackfoot 10 Learning Strategies	Blackfoot 20 Learning Strategies	Blackfoot 30 Learning Strategies
Students will:	*Students will:*	*Students will:*
4.1 watch and listen for clues to meaning in the context by: • identifying familiar words, phrases or expressions • identifying what is familiar about the context.	4.1 watch and listen for clues to meaning in the context by: • identifying familiar sentence structures.	4.1 watch, listen and read for clues to meaning in the context.
4.2 construct meaning by: • identifying or expressing purpose or main idea • recognizing logical and temporal sequence.	4.2 construct meaning by: • identifying or expressing main ideas and supporting ideas • summarizing or outlining • using temporal and logical sequence.	4.2 construct meaning by: • recognizing and using metaphors • paraphrasing • translating • making inferences • interpreting.
4.3 guess the meaning on the basis of what they can understand or recognize.	4.3 guess the meaning on the basis of what they can understand or recognize.	4.3 guess the meaning on the basis of what they can understand.
4.4 demonstrate an ability to use basic strategies to derive or communicate meaning by: • using appropriate expressions to show lack of understanding • recognizing when others do not understand.	4.4 demonstrate an ability to use basic strategies to derive or communicate meaning by: • recognizing when others do not understand and attempting to re-establish communication.	4.4 demonstrate an ability to use basic strategies to derive or communicate meaning by: • asking appropriate and effective questions to get clarification • paraphrasing or summarizing the communications of others to check for understanding • recognizing when others do not understand.
4.5 use appropriate methods to complete a message by: • using the first language • getting help • using alternative words or phrases.	4.5 use appropriate methods to complete a message when they do not know certain words or phrases by: • using alternative words or phrases • breaking message into smaller parts.	4.5 use appropriate methods to complete a message when they do not know certain words or phrases by: • using alternative words or phrases • breaking message into smaller parts.
4.6 plan their own learning and monitor their own progress.	4.6 plan their own learning and monitor their own progress.	4.6 plan their own learning and monitor their own progress.

GENERAL LEARNER EXPECTATION 5: EXPERIENCE USING THE LANGUAGE

Students will demonstrate an ability to use language in the context of experiences taken from their everyday lives as well as from the Blackfoot culture.

Blackfoot 10 Experience Using the Language	Blackfoot 20 Experience Using the Language	Blackfoot 30 Experience Using the Language
Becoming Familiar with One's World *Students will:* 5.1 Human Relationships • demonstrate awareness of relationships in Blackfoot families • demonstrate a growing appreciation of their families in their various contexts • begin to comprehend the Blackfoot language as it is used in family interactions and activities, or in describing family members and their roles: – Family as a Kinship Unit • nuclear family members, roles, responsibilities • extended family members, roles, responsibilities – Family as a Social Unit • social conventions • social activities • social responsibilities • patterns of interaction and communication • education • hobbies, interests, leisure, recreation • health • beliefs/religion • political membership	Developing an Understanding of One's World *Students will:* 5.1 Human Relationships • demonstrate understanding of the roles and relationships between themselves and the Blackfoot community • begin to use the Blackfoot language to interact in various relationships in the Blackfoot community: – Community Services • health • drugs and alcohol abuse • friendship centres • policing • employment agencies • other – Economy • retail • agriculture • manufacturing industry • construction • service – Education • types of schools • staff and students • services • other – Government • band or municipal government • roles and functions • other	Expanding One's World View *Students will:* 5.1 Human Relationships • demonstrate understanding of various social issues as they affect themselves • begin to use the Blackfoot language to express and explore ideas and feelings while studying the following social issues: – electoral process – judicial system – band or federally controlled schools – rural or urban lifestyles – Native contributions to technology – personalities in sports – olympics – religious beliefs and practices – health issues – issues from history (pioneers, traders, North-west Mounted Police, missionaries) – other.

Blackfoot 10 Experience Using the Language	Blackfoot 20 Experience Using the Language	Blackfoot 30 Experience Using the Language
5.1 Human Relationships (continued) – Family as an Economic Unit • livelihood • buying • food • clothing • shelter • transportation – Family in a Community Setting • rural • urban.	5.1 Human Relationships (continued) – Sports • role models • various activities • other – Recreation • organizations • various activities – Religion • denominations • beliefs • other.	
5.2 Relationship to the Natural Environment • demonstrate awareness and knowledge of their immediate environment • begin to comprehend the Blackfoot language as it is used in activities dealing with the immediate environment, or in identifying and describing aspects of the immediate environment: – plant and animal identification – weather – seasons – time – simple geographic features.	5.2 Relationship to the Natural Environment • demonstrate understanding of humankind's relationship to the environment • begin to use the Blackfoot language to identify and describe concepts dealing with humankind's relationship to the environment: – science • human body • animal species • systems of measurement – the Native Reserve: • people • location • geography • demography • maps • economy • climate – other.	5.2 Relationship to the Natural Environment • be able to apply their knowledge of humankind's relationship to the natural environment in ways that are personally meaningful in the area of science and technology: – science and technology • pollution—sources and effects • respect and care for the environment • geographic features of the environment – travel • air • land • water – other.

Blackfoot 10 Experience Using the Language	Blackfoot 20 Experience Using the Language	Blackfoot 30 Experience Using the Language
5.3 Cultural Lifestyles • recognize and appreciate the important role of Blackfoot culture in their daily lives as they experience it directly or indirectly: – food – customs • ceremonies • rituals • celebrations – arts • crafts • art • music • dance – legends and mythology – spirituality and beliefs.	5.3 Cultural Lifestyles • begin to perceive Blackfoot culture from a contemporary and historical perspective: – communication • Native newspapers • oral tradition: legends, jokes, origin stories • pictographs – technology • survival versus craft • clothing • shelter • food – geneology – special holidays – values – education • residential schools • provincial schools • band controlled schools – other.	5.3 Cultural Lifestyles • understand and appreciate contemporary Blackfoot lifestyles through the study of its origins: – pre-contact culture and history • major events • chronology of Native history • biographies of famous Native figures • pre-literate education – contemporary culture and history • chronology of contemporary Native events • study of other North American tribes • Native organizations and societies • values and mores • healing practices – other.

GENERAL LEARNER EXPECTATION 6: CULTURAL ATTITUDES

Students will demonstrate a positive self-concept, confidence, pride and self-esteem as a result of knowing and experiencing the Blackfoot language and culture.

Blackfoot 10 Cultural Attitudes	Blackfoot 20 Cultural Attitudes	Blackfoot 30 Cultural Attitudes
Students will:	*Students will:*	*Students will:*
6.1 demonstrate an appreciation of Blackfoot values and beliefs related to responsibility for family members.	6.1 demonstrate an appreciation of Blackfoot values and beliefs related to responsibility for community members.	6.1 demonstrate an appreciation for Native philosophy and values related to global citizenship.
6.2 demonstrate an appreciation of Blackfoot art forms.	6.2 demonstrate an appreciation of Blackfoot art forms through participation.	6.2 demonstrate an appreciation of Blackfoot art forms by participating creatively in Blackfoot and other Native arts.
6.3 understand and accept differences in race and culture among their acquaintances and family.	6.3 understand and accept differences in race and culture in the community or on the reserve.	6.3 demonstrate tolerance and understanding of both Native and non-Native cultures.
6.4 pursue independently, personal development in language and culture in the immediate environment.	6.4 pursue independently, personal development in language and culture in the community.	6.4 pursue independently, personal development in language and culture outside the community.
6.5 demonstrate willingness to promote the development of the Blackfoot language and culture.	6.5 demonstrate willingness to promote the development of the Blackfoot language and culture.	6.5 demonstrate willingness to promote the development of the Blackfoot language and culture.
6.6 demonstrate willingness to participate in cultural activities.	6.6 demonstrate willingness to participate in cultural activities, and to get others involved as well.	6.6 demonstrate willingness to participate in cultural activities, and to get others involved as well.

CREE LANGUAGE AND CULTURE 10–20–30

A. PROGRAM RATIONALE AND PHILOSOPHY

CREE PEOPLE AND THE CREE LANGUAGE

To the Cree, as to most ethnic and cultural groups, their language is more than a form of communication. Language is inextricably linked with beliefs and customs.

Traditionally, Cree Elders were storytellers who amused and educated listeners for hours by telling repeated versions of Cree stories using humour, analogy and dramatization. In this way, the history, knowledge, values and sacred beliefs of the Cree-speaking nations have been transmitted from generation to generation for thousands of years. The oral tradition is the link among generations past and present, and those who are yet to be born.

The Cree language is the medium for passing down culture; but it is also the essence of the culture. The Cree language expresses a lifestyle and a world view. It expresses the Cree people's spiritual relationship with nature, with others and with their Creator. The Cree language is central to Native identity, family bonding and kinship ties. It is also central to traditional Cree skills, such as negotiating and reaching consensus. Therefore, the Cree language offers significant and profound insights into the Cree culture.

HISTORY OF CREE LANGUAGE AND CULTURE

Various events, past and present, have progressively eroded the Cree language and culture. Social and economic upheaval, beginning with European contact, brought many changes for the Cree-speaking nations. Formal schooling programs tended to separate children from their families and strictly prohibit communication in the Cree language. Because of this separation over time, most Native youth today have little or no knowledge of the Cree language and culture. Many Native children do not speak the Cree language at home. This is a serious concern to most of the Elders in Cree-speaking communities.

REVIVAL OF CREE LANGUAGE AND CULTURE

The Cree, in searching for their traditional values and culture, have come to realize the importance of relearning, renewing and reviving the Cree language and culture. Many Native people and Native organizations are now interested in establishing Cree language programs in schools.

In response to these interests and needs, Alberta Education has worked with Cree communities to produce a Cree program for Alberta high schools. This program provides students with opportunities to study Cree language and culture, and in doing so, help it to flourish once again.

CREE LANGUAGE PROGRAM

The program states goals and objectives for developing Cree language skills, cultural knowledge and cultural attitudes. The cultural component of the program includes Cree values and emphasizes traditional practices, such as storytelling and respect for Elders. The program also reflects the seasonal and cyclical nature that is manifested in Cree cultural beliefs and customs.

The curriculum is community-based. The teachers are expected to work closely with the community of parents and Elders, and to involve Elders and community leaders in the delivery of the program. Elders and community leaders will act as advisors and provide direction and guidance to facilitate the learning of the language and cultural content.

In this program, the broad objectives are called "general learner expectations", to emphasize the importance of the learner. The student's development of Cree language proficiency occurs through experience. The learner must use the language in order to learn it. In this program, proficiency in the Cree language includes knowledge of culture, awareness of attitudes that encourage "Nativeness" and knowledge of language learning.

The specific learner expectations describe what communicative skills and attitudes students should acquire, and what general knowledge they should have of the Cree language and language learning. Teachers are to relate these expectations to real-life experiences that are explicitly or implicitly cultural. The language expectations should be met by teaching and evaluating language skills and knowledge together with cultural learning.

The teacher should adapt the expectations for cultural learning in this program to suit the community's circumstances, conditions and needs.

OUTCOMES

This senior high school Cree language and culture program will help students in several ways. Cree students today need to be reacquainted with their culture. As well, language is a powerful medium for expressing oneself; it is an important instrument in developing self-awareness and identity, which is the first step in any kind of personal growth. Equally important is the need to foster positive attitudes, which also promote self-awareness and self-esteem. By focusing on the Cree language and culture through this program, students will further appreciate and value their Cree heritage and identity. Traditionally, it was through language that the Cree maintained strong bonds with family, tribal kin and nature. It is hoped that the Cree children of today will be able to develop a social cohesiveness and feel a sense of belonging as they learn their language. The Cree-speaking people, both Indian and Metis, wish to define further their identity as a distinct people by maintaining their language and culture.

The knowledge and skills provided by the Cree language and culture program will have practical value as well. As more emphasis is placed on Native communications and culture, there will be job opportunities in this area. Credit in the program can be used to fulfill the second language entrance requirement of many colleges and universities.

The program has potential beyond the significant benefit it will provide to individual students. The Cree world view, essentially coexistence in harmony with nature, is suddenly of interest to many who are concerned about environmental issues. Similarly, there is a place in the world for the Cree values of giving, sharing, cooperation and humility. These Cree teachings, whether transmitted by Elders to young people, or from Cree to non-Cree, could help to promote and foster greater tolerance and understanding among Albertans.

B. GENERAL LEARNER EXPECTATIONS

The general learner expectations describe, in broad terms, what knowledge, skills and attitudes students should be able to demonstrate as a result of their learning experiences in the Cree Language and Culture 10–20–30 Program.

The general learner expectations for this program are:

1. Experience Using the Language

   Students will have experience using the Cree language in situations where the Cree culture is explicit or implicit. In these situations, students will demonstrate the following specific skills and attitudes:

   1.1 an ability to communicate fluently and effectively

   1.2 an ability to communicate for a variety of purposes

   1.3 an ability to communicate in a variety of situations

   1.4 a willingness to adopt and maintain attitudes that foster learning of the language and culture

   1.5 an ability to interact appropriately in Cree cultural situations.

2. Knowledge about Language and Language Learning

   Students will demonstrate an ability to apply general knowledge about language and language learning to their learning of the Cree language.

3. Culture

   Students will demonstrate a knowledge and appreciation of aspects of the Cree culture, its attitudes and values.

C. SPECIFIC LEARNER EXPECTATIONS

The specific learner expectations expand on each of the general learner expectations. They are explicit statements about what students are expected to achieve. The expectations serve as benchmarks to indicate stages in students' development of their language and cultural proficiency.

The expectations move the students from concrete and familiar knowledge to more abstract and applied knowledge. They also move the students from the skills required to interact in controlled or predictable situations to those requiring more spontaneous and creative interaction.

REQUIRED AND ELECTIVE COMPONENTS

The instructional time for the Cree 10–20–30 program is to be allocated as follows:

- 80% required component
- 20% elective component.

The **required component** of the program consists of all the language and cultural expectations outlined in the program statements.

The **elective component** of the program consists of language and cultural expectations that allow the teacher to:

- remediate or reinforce skills, concepts and attitudes from the required component
- extend or enrich the program to meet particular student or Cree community interests
- meet the instructional needs of minority students, who may be either students whose first language is Cree or students who may be learning Cree as a second language.

GENERAL LEARNER EXPECTATION 1: EXPERIENCE USING THE LANGUAGE

Students will have experience using the Cree language in situations where the Cree culture is explicit or implicit. In these situations, students will demonstrate the following specific skills and attitudes:

Cree 10	Cree 20	Cree 30
Students will:	*Students will:*	*Students will:*
1.1 be able to communicate in language experiences that have these attributes: • topics are familiar and interesting to them • actions and language are predictable, structured and/or repetitive • body and verbal language are informal • audience is sympathetic, and speakers speak clearly • cultural content and activities are related to the Cree 10 program.	1.1 be able to communicate in language experiences that have these attributes: • topics are familiar to them • actions and language are predictable or routine • information and interaction is less structured • body and verbal language are informal • audience is sympathetic, and speakers speak clearly • cultural content and activities are related to the Cree 20 program.	1.1 be able to communicate in language experiences that have these attributes: • topics are varied • situations are predictable • situations are unstructured • formal language (speeches, counselling and prayers) is used in a limited number of situations • audience is neutral, and speakers speak naturally • cultural content and activities are related to the Cree 30 program.
1.2 be able to communicate in language experiences by: • understanding and producing simple words, phrases, expressions and sentences appropriate to the social and cultural context • emphasizing meaning rather than form • using appropriate body language • displaying poise and animation.	1.2 be able to communicate in language experiences by: • understanding and producing simple words, phrases, expressions and sentences appropriate to the social and cultural context • paying attention to meaning, as well as to accuracy of form • using appropriate body language • displaying poise and animation.	1.2 be able to communicate in language experiences by: • understanding and producing expressions and complex sentences appropriate to the social and cultural context • paying increasing attention to accuracy of form • displaying poise and animation.

Cree 10	Cree 20	Cree 30
1.3 be able to communicate in different language situations to achieve the following purposes: • asking questions and giving simple answers • understanding and giving directions • understanding and producing descriptions • understanding and giving commands • understanding and expressing straightforward feelings and attitudes • understanding simple oral and written texts on familiar topics, in the form of narratives, legends and myths, short stories, anecdotes, prayers, songs and poetry • writing short, simple compositions in the form of letters, poetry, songs, prayers, short stories, narratives and descriptions.	1.3 be able to communicate in different language situations to achieve the following purposes: • requesting and reporting information • initiating discussion • providing simple explanations • engaging in limited social conversation • meeting routine needs • understanding and expressing straightforward feelings and attitudes • understanding simple oral and written text on somewhat unfamiliar topics, in the form of legends and myths, short stories, anecdotes, narratives, prayers, songs, poetry, Cree radio and other media forms • writing compositions of increasing complexity, length and content, in the form of letters, poetry, songs, prayers, short stories, narratives, descriptions, family histories, autobiographies, simple reports.	1.3 be able to communicate in different language situations to achieve the following purposes: • discussing • discussing and seeking consensus • solving problems • exploring and evaluating ideas critically • providing insight • brainstorming • understanding and expressing increasingly subtle and complex feelings and attitudes • understanding oral and written texts on unfamiliar topics, in the form of legends and myths, short stories, narratives, prayers, songs, poetry, Cree radio and other media forms and Elders' talk (history, legends, counsel) • writing a variety of compositions of increasing complexity, in the form of letters, poetry, songs, prayers, short stories, narratives, descriptions, oral histories, transcriptions of legends and oral prose, biographies, reports and short essays.

Cree 10	Cree 20	Cree 30
1.4 demonstrate a willingness to adopt and maintain attitudes that foster learning of the language and culture, in language experiences appropriate for Cree 10: • take risks in attempting to understand others • take risks to communicate with others • tolerate some ambiguity or uncertainty in their own minds and in the minds of others • maintain a sense of humour.	1.4 demonstrate a willingness to adopt and maintain attitudes that foster learning of the language and culture, in language experiences appropriate for Cree 20: • take risks in attempting to understand others • take risks to communicate with others • tolerate some ambiguity or uncertainty in their own minds and in the minds of others • maintain a sense of humour.	1.4 demonstrate a willingness to adopt and maintain attitudes that foster learning of the language and culture, in language experiences appropriate for Cree 30: • take risks in attempting to understand others • take risks to communicate with others • tolerate some ambiguity or uncertainty in their own minds and in the minds of others • maintain a sense of humour.
1.5 demonstrate awareness of and respect for the courtesies of interaction (e.g., knowing when to speak, listen, how to use humour) in language experiences appropriate to Cree 10.	1.5 practise the courtesies of interaction in language experiences appropriate to Cree 20.	1.5 practise the courtesies of interaction in language experiences appropriate to Cree 30.

GENERAL LEARNER EXPECTATION 2: KNOWLEDGE ABOUT LANGUAGE AND LANGUAGE LEARNING

Students will demonstrate an ability to apply general knowledge about language and language learning to their learning of the Cree language. (The teacher will aim for initial exposure to grammar and work, over time, toward mastery.)

Cree 10	Cree 20	Cree 30
Students will: 2.1 demonstrate an understanding of the Cree linguistic code and an ability to use it to increase accuracy of communication: • Phonology: demonstrate knowledge of the basic sound system of Cree, focusing on vowels and consonants not found in English • Grammar: demonstrate knowledge of the following grammatical elements as they apply to words and sentences they have learned in language experiences: – nouns: animate and inanimate, singular and plural dependent nouns – pronouns: demonstrative, singular and plural, personal pronouns, address forms – locatives and prepositions – common question forms – verbs: animate and inanimate, transitive and intransitive, imperative, singular and plural persons, present tense, indicative and inverse, subjunctive, past tense, future tense, transitive with direct object	*Students will:* 2.1 demonstrate an understanding of the Cree linguistic code and an ability to use it to increase accuracy of communication: • Phonology: begin to study phonological changes in word stems. This study will be based on words already learned: – various noun stems – various verb stems • Grammar and Syntax: begin to rely on their knowledge of grammatical elements to increase accuracy in communication. In addition to becoming increasingly familiar with the grammatical elements from Cree 10, students should become familiar with the following: – comparatives – reflexives – indirect objects – conditionals – other more complex verb tenses • Lexicon: be able to use words with increasing accuracy while expressing themselves and receiving information in language experiences appropriate for Cree 20 (content words, functions, notions)	*Students will:* 2.1 demonstrate an understanding of the Cree linguistic code and an ability to use it to increase accuracy of communication: • Grammar, Syntax and Phonology: continue the study of the elements of Cree 10 and 20 grammar, syntax and phonology, and consistently apply this knowledge with increasing accuracy in communication situations • Literacy: be able to associate Cree sounds with Roman and syllabic orthographies with increasing speed and accuracy, while expressing themselves and receiving information in the form of sentences or paragraphs • Lexicon: be able to use words with increasing accuracy while expressing themselves and receiving information in language experiences suitable for Cree 30 (content words, functions, notions) • demonstrate awareness and appreciation of the Cree oral tradition and effective Cree oral communication styles.

Cree 10	Cree 20	Cree 30
– negative and affirmative – reflexive forms • Lexicon: be able to use words while expressing themselves and receiving information in language experiences appropriate for Cree 10 (content words, functions, notions) • Literacy: be able to associate Cree sounds with a preferred orthography (either Roman or syllabic) while expressing themselves or receiving information in the form of words, phrases and simple sentences (vowels, consonants, syllables, intonation, glottal stops).	• Literacy: be able to associate Cree sounds with a preferred orthography (either Roman or syllabic) with increasing speed and accuracy, while expressing themselves or receiving information in the form of words, phrases and simple sentences.	
2.2 demonstrate an ability to use basic strategies to derive or communicate meaning: • watch and listen for clues to meaning in context by: – identifying familiar words, phrases or expressions – identifying what is familiar about context • construct meaning by: – identifying or expressing purpose or main idea – recognizing logical and temporal sequence • guess the meaning on the basis of what they can understand or recognize • recognize when others do not understand • use expressions to show lack of understanding	2.2 demonstrate an ability to use basic strategies to derive or communicate meaning: • watch and listen for clues to meaning in context by: – identifying familiar sentence structures • construct meaning by: – identifying or expressing main ideas and supporting ideas – summarizing or outlining – using temporal and logical sequence • guess the meaning on the basis of what they can understand or recognize • recognize when others do not understand and attempt to re-establish communication	2.2 demonstrate an ability to use basic strategies to derive or communicate meaning: • watch, listen and read for clues to meaning in context • construct meaning by: – recognizing and using metaphors – paraphrasing – translating – making inferences – interpreting • guess the meaning on the basis of information they can understand • ask appropriate and effective questions to get clarification • paraphrase or summarize communications of others to check for understanding

Cree 10	Cree 20	Cree 30
• use appropriate methods to complete a message; e.g., use the first language, get help, use alternative words or phrases.	• use appropriate methods to complete a message when they do not know certain words or phrases; e.g., use alternative words or phrases, break message into smaller parts.	• recognize when others do not understand • use appropriate methods to complete a message when they do not know certain words or phrases; e.g., use alternative words or phrases, break message into smaller parts.
2.3 begin to establish personal objectives for a given task and monitor their own learning.	2.3 plan their own learning and monitor their own progress.	2.3 seek opportunities to practise and evaluate themselves.

GENERAL LEARNER EXPECTATION 3: CULTURE

Students will demonstrate a knowledge and appreciation of aspects of the Cree culture, its attitudes and values. (The teacher will choose from the following cultural components in adapting the cultural content to the needs and interests of the community and individual students.)

Cree 10	Cree 20	Cree 30
Students will: 3.1 Relationship to the Spirit World • Ceremonies and Rituals: – demonstrate familiarity with Native spirituality as it is expressed and practised in Native ceremonies and rituals – demonstrate an appreciation of and respect for Native ceremonies and rituals – be exposed to a selection of the following rituals and ceremonies, either through field trips or in-school spiritual ceremonies. These rituals and ceremonies should be conducted by members of the Cree community: • prayer and meditation • pipe ceremony • feasts and thanksgiving • memorial service • sweat lodge and healing • tobacco and gift giving • sweet grass • tobacco as an offering • personal quest through fasting • vision quest • Sun dance • rituals in hunting • name giving • sunrise ceremony	*Students will:* 3.1 Relationship to the Spirit World • Ceremonies and Rituals: – demonstrate, as a result of continued participation in Native ceremonies and rituals as practised by the Cree community: • a growing awareness of Native spirituality • a growing appreciation of and respect for Native ceremonies and rituals.	*Students will:* 3.1 Relationship to the Spirit World • Ceremonies and Rituals: – demonstrate, as a result of continued participation in Native ceremonies and rituals as practised by the Cree community: • a growing appreciation of and respect for Native ceremonies and rituals • personal spiritual growth.

Cree 10	Cree 20	Cree 30
• celebration of life's passages (birth, marriage, death, etc.) • rituals in Christianity • others.	• demonstrate a familiarity with and an understanding of Native spirituality as it is expressed in recurring or important symbols of the Native culture. To this end, the teacher should choose topics for instruction from the list below. Instruction should involve a community of Cree Elders: – sacred circle – the medicine wheel – the four directions – flags and colours – braided sweet grass – the eagle feather – selecting a name – ceremonial dress – dance as spiritual expression – honour by song – dance of the northern lights – ownership of the pipe – the eagle lands – the drum – a buffalo skull – Mother Earth – oral stories – contemporary Native art forms – others.	• demonstrate a knowledge of the concepts basic to Native spirituality as expressed in Native philosophy and mythology. To this end, the teacher should choose topics for instruction from the list below. Instruction should involve a recognized Cree Elder from the community: – Native philosophy: • the order of the universe: respect for life and humankind's place in the order • the relationship of the whole to its parts: - unity and harmony - family and community - body, mind and spirit - earth • linear versus circular • wisdom and Eldership • prophesy, dreams and omens • intuition as a gift • others – Cree mythology: • the creation story: - genesis - moral values • Wesakechak before the flood • the flood • Wesakechak as a trickster • how plants and animals came to be • others.

Cree 10	Cree 20	Cree 30
Students will: 3.2 Relationship to Nature • demonstrate an awareness of their immediate natural environment and how it relates to contemporary Cree lifestyles. To this end, the teacher should choose topics for instruction from the list below: – natural environment: • common plants and animals • weather and climate • topography and terrain • time and seasons • renewable resources • others – contemporary lifestyles based on the environment: • planting and harvesting • food preparation and preservation • seasonal big game hunting • small game hunting • hides and tanning • wild food gathering • fishing • trapping • seasonal social and spiritual gatherings • others.	*Students will:* 3.2 Relationship to Nature • demonstrate an understanding of and appreciation for the Native view that humankind's survival is dependent on nature, and therefore nature should be respected. To this end, the teacher should choose topics for instruction from the list below. These topics relate to the beliefs and practices of the Cree of long ago, which have ensured their survival and the survival of succeeding generations: – conservation: • take only what you need • use all that is taken – rituals and ceremonies: • showing respect to nature • reinforcing a sense of humility • others – working with the forces of nature: • the elements • time and seasons • others – knowledge and skills for survival: • hunting and gathering • preparing hides • travel pathways and waterways • herbal remedies • forecasting weather • animal behaviour and characteristics • others.	*Students will:* 3.2 Relationship to Nature • demonstrate an ability to use their understanding of the Native view of nature in examining various contemporary issues. To this end, the teacher should choose topics for instruction from the list below: – use of non-renewable resources – depletion of forests – pollution – global warming – ozone warming – plant and animal extinction – land and soil technology, such as dams, fertilizers – forest fires and drought – others.

Cree 10	Cree 20	Cree 30
Students will: 3.3 Human Relationships • Family and Community – demonstrate knowledge of and an appreciation for the Cree way of relating to others in their family and community – demonstrate understanding and acceptance of racial and cultural differences among their acquaintances and family To this end, the teacher should choose topics for instruction from the list below: • relationships with family: - nuclear and extended family - responsible relationships: caring, sharing and respect: • sibling interactions • Elders • family workers • others - family fun and recreation - cultural activities done as a family: berry picking, hunting, camping - working for and with each other: hunting/ trapping, farming, wage employment, business, others	*Students will:* 3.3 Human Relationships • History – demonstrate their knowledge of the history of the Cree-speaking people and their relationship to other groups – demonstrate an understanding and acceptance of the differences among races and cultures in the history of the Alberta Cree To this end, the teacher should choose topics for instruction from the list below: • traditional relationships in camps: - roles of camp members • hunters and gatherers • Elders • children and youth • specialists: canoe makers, healers, storytellers, societies - social conventions - forms of recreation • intertribal affiliations: - territorial hunting grounds	*Students will:* 3.3 Human Relationships • Contemporary Issues – use knowledge of the history of the Cree and knowledge of Native perspectives on humankind's relationship to each other to get a better understanding of contemporary issues affecting Native people – demonstrate an understanding and acceptance of the differences among races and cultures while dealing with contemporary issues To this end, the teacher should choose topics for instruction from the list below: • societal issues: - stereotyping - urbanization - justice/penal system - education policies - health - substance abuse - others • political/economic issues: - reserve lands - aboriginal land claims - treaty rights - self-government - Metis settlements - political bureaucracy - others

Cree 10	Cree 20	Cree 30
- family-related issues: • care of Elders and handicapped • drug and alcohol abuse • family breakdown • nutrition • others • relationships with other Cree speakers and Native people: - social gatherings and meetings: • wakes and memorials • sports days and rodeos • friendship centres • powwows • community feasts • others - social conventions: • greeting Elders, waiting to be spoken to by Elders and adults, not walking in front of Elders • sharing in planning and providing for gatherings • gift giving for recognition • use of humour: good and bad - value and importance of gatherings to Cree speakers - others	- alliances, warfare and trade - system of communication - others • political/economic issues: - reserve lands - aboriginal land claims - treaty rights - self-government - Metis settlements - political bureaucracy - others • historical events: - introduction of the horse - fur trade and technology - missionaries and Christianity - Metis nation - expansion of the railroad and European settlement • extinction of the buffalo • epidemics • restricted hunting • others • Native contributions: - legends - food - herbal remedies - artists and musicians - arts and crafts - role models - philosophy/ ideology/values - others.	

Cree 10	Cree 20	Cree 30
• relationship to institutions in the community: - school - police/fire department - church - media/ communication - hospital or clinic - entertainment/ recreation.		• demonstrate a willingness to seek and convey the Native perspective independently when dealing with contemporary issues that affect Native people. • demonstrate a willingness to interact with Native people independently, and engage in activities that contribute positively to the welfare and image of Native people.

OTHER COURSES

CONTENTS

Special Projects 10–20–30

Work Experience 15–25–35

SPECIAL PROJECTS 10–20–30

Special projects credits are designed to recognize work undertaken by students on an individual or small group basis and should not be used as a means of offering credits for unapproved courses. Students may enroll in Special Projects 10, 20 or 30. Special Projects 20 and Special Projects 30 do not have prerequisites.

PURPOSE

Special projects credits perform two major functions:

- Students become involved in the selection, planning and organization of their own programs.
- Students pursue activities in which they have considerable interest or ability but which are not within the scope of the regular curriculum or the programs being offered in the school.

PROCEDURES

Requirements for special projects credits are:

- Each project shall be carried out under the supervision of a teacher.
- Students are required to submit a clearly planned proposal to the principal for approval. The proposal should include:
  - a description or outline of the project
  - the number of hours of work expected to complete the project
  - a method by which the project will be carried out
  - a description of the expected result
  - the evaluation procedures as outlined by a teacher
  - an expected completion date
  - the name of the supervising teacher.
- The principal shall retain a copy of each special project proposal until the project is completed.
- The opportunity to earn special projects credits shall be available to all students, including those attending an authorized summer school.
- The content of the special project need not be related to a specific school subject.
- If a special project is related to a specific school subject, the content of the project shall be distinct from and in addition to regular course requirements.
- Projects shall be completed and reported to the principal prior to the conclusion of the semester or full term.
- Where a project takes a student off campus, the provisions of the *Off-campus Education* policy (see *Alberta Education Policy, Regulations and Forms Manual*) shall apply.
- Special projects credits may be applied toward the Alberta High School Diploma and, until 1997, toward the Advanced High School Diploma (as unspecified credits only), and to the General High School Diploma (as either specified or unspecified credits).
- Students who successfully complete projects are granted 3 credits for 75 hours of work or 5 credits for 125 hours of work in any one semester, or full term on the approval of the principal.

- School jurisdictions shall develop policies to ensure overall consistency and standardization of procedures governing special projects in their schools. Evaluation and reporting procedures should be included in the policy.

Restrictions on special projects are:

- Special projects credits shall not be awarded for student activities that would be considered a normal part of extracurricular or cocurricular activities generally offered by a school; e.g., school team sports, school newspaper, yearbook.
- In instances where a student enrolls in more than one special project, credits shall not be approved unless the projects vary substantially from year to year or demonstrate increased levels of proficiency.

WORK EXPERIENCE 15–25–35

Work Experience 15–25–35 are separate courses for credit that provide experiential learning activities undertaken by a student as an integral part of a planned school program under the cooperative supervision of a teacher–coordinator and employer.

Work Experience 15–25–35 courses are components of an off-campus education program. These courses, like other off-campus education courses and course components, provide opportunities for students to:

- apply, in the workplace, knowledge, skills and attitudes acquired through other course work
- discover their career interests and aptitudes in meaningful work activities, situated in community-based work stations and work sites in business, industry, government and community service.

Work experience courses also provide opportunities for the school and its community to combine resources to further the student's personal development, career planning and employability skills through placements in off-campus work stations or work sites.

Off-campus education programs are a major thrust within Alberta Education's *Meeting the Challenge: Three-Year Business Plan*. The document states that:

> Senior high school students will be able to learn employability skills in the workplace. The school will provide support to ensure a broad theoretical understanding for those specific skills. The province will provide high school credit for workplace learning that is certified by the school and by the employer. This will ensure students have the skills demanded by business and gain recognized work experience to assist in making the transition from school to work.

Work Experience 15–25–35 courses, at each level, may be offered for 3, 4, 5, 6, 7, 8, 9 or 10 credits. Each course is time based; i.e., 25 hours per credit, and a student may enroll in Work Experience 35 without having completed Work Experience 15 and/or Work Experience 25.

For students who entered Grade 10, as of September 1994, the number of work experience credits that may be counted toward the Alberta High School Diploma is fifteen.

There are no basic learning resources for Work Experience 15–25–35 courses. However, related support resources are available for the Career Readiness modules in the Career Transitions strand of the Career and Technology Studies program. These resources are listed in the *Career Transitions Guide to Standards and Implementation*, Interim 1995.

Career Readiness modules are linked to Work Experience 15–25–35 courses as follows:

- Module CT101: Job Preparation, will be a <u>required</u> component of the first work experience course taken by a student.

- Module CT201: Job Maintenance, will be a recommended component of the second work experience course taken by a student.

- Module CT301: Preparing for Change, will be a recommended component of the third work experience course taken by a student.

Specific procedures and legislation about off-campus education and work experience courses are provided in the *Off-campus Education Guide for Administrators, Counsellors and Teachers*, 1995, and the *Alberta Education Policy, Regulations and Forms Manual*.

PHYSICAL EDUCATION

A. PROGRAM RATIONALE AND PHILOSOPHY

The aim of the Kindergarten to Grade 12 physical education program is to enable individuals to develop the knowledge, skills and attitudes necessary to lead an active, healthy lifestyle.

Alberta's vision for education focuses on children and their ability to achieve their individual potential, creating a positive future for themselves, as well as enhancing their quality of life. The Kindergarten to Grade 12 physical education program contributes to the development of life skills for the personal management of health, for the use of physical activity as a strategy for managing life challenges, and for a setting within which to practise the ability to work with others. The program provides an equitable opportunity for all students to realize the benefits of participation in physical activity.

Education is a shared responsibility involving students, parents, teachers, the school and the community. Within each day, whether at home, school, or in the community, there is structured and unstructured time available for meeting the aim of the physical education program that contributes to student well-being. As the benefits of physical activity increase proportionally as a result of the time and intensity provided, consideration should be given to maximizing the amount of time available within the school context. An approach that is sensitive to developmental and culturally appropriate practice, and that emphasizes enjoyable participation, is most likely to foster a desire in students to participate in lifelong physical activity.

Physical activity is vital to all aspects of normal growth and development, and the benefits are widely recognized. Students do not develop automatically the requisite knowledge, skills and attitudes that lead to active, healthy lifestyles. Such learning should begin in childhood. Schools and teachers can be prime facilitators in providing opportunities for the development of the desire for lifelong participation in physical activity.

Active Living

The physical education program emphasizes active living, with a focus on physical activity that is valued and integrated into daily life.

Active living through physical education:

- creates a desire to participate
- focuses on lifetime activities promoting health-related fitness for life
- is about physical activity; and the nature, form, frequency and intensity of the activity are relative to each person's ability, needs aspirations and environment
- places physical activity within a broader perspective of total fitness and well-being that encompasses the entire experience of

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movement—physical, mental, emotional and social dimensions
- is enhanced through opportunities to participate in such activities as intramural and interschool athletics and community-based sport and recreation activities
- is centred around learner needs; inclusive, individual and varied
- is supported when opportunities for making choices are provided
- is supportive of the relevance of physical activity within the community.

Benefits of Physical Education and Activity

Strong evidence exists that physical activity contributes to the overall well-being of individuals. People of all ages can substantially improve their health and quality of life by including a moderate amount of physical activity into their daily routines. Participation in physical activity contributes to physical, mental and social well-being providing benefits to the individual and the community. Below are some reasons why students need physical education on a regular basis.

- Health
  Participation in physical activity can improve fitness—muscular strength, flexibility, muscular endurance, body composition and cardiovascular endurance—and reduce the risk factors related to heart disease, including obesity and high blood pressure. Regular physical activity increases bone density to create a stronger skeleton. It can be an outlet for releasing tensions and anxieties in the promotion of mental health.

- Active Lifestyle
  Physical activity, over time, is beneficial to personal well-being. Physical education promotes personal responsibility for health and fitness and for students to develop a desire to participate for life.

- Skill Development
  Physical education develops physical skills that allow for enjoyable and successful participation in movement activities. Students perceived competence is a key determinant for future involvement in physical activity.

- Positive Interactions
  Interaction with others is an important aspect of most physical activities. Physical education provides a natural learning environment in which to develop cooperation and fair play skills. For example, students have opportunities to assume leadership, develop teamwork skills, officiate and take responsibility for their actions while playing.

- Self-confidence and Self-esteem
  Physical activity can instill a strong sense of self-worth in students. They can become more confident, assertive and independent.

- Goal Setting
  Physical education provides opportunities for students to practise goal setting as they participate.

- Economic
  Physical activity can improve health, which reduces the cost of health care for individuals and the community.

- Academic Achievement
  Time allocation for physical education programs does not limit academic achievement; in fact, it can contribute to increased achievement levels; i.e., active bodies/active minds.

Student Learning and Achievement

Students will meet the aim of the physical education program, to lead an active, healthy lifestyle, if they have developed a desire to participate regularly in physical activity. The aim can only be achieved by addressing the prescribed outcomes within an environment wherein students are emotionally and physically safe, the climate is

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positive, and a variety of developmentally appropriate skill-building experiences are provided.

Curriculum experiences provide students with opportunities to develop the habit of being active daily, the skills to enjoy successful participation, and to realize the benefits resulting from activity. This is the focus of an "active living" approach.

There are many factors to be considered in providing a context wherein students can achieve. Planning will help to determine ways in which to provide a program that addresses the outcomes and meets the diverse needs of learners. Some of the factors to consider when planning include:

- activity that is relevant, meaningful and enjoyable
- student equity and diversity
- alignment of learning outcomes, instructional and assessment practices
- practices that apply the principles of learning
- experiences from all movement dimensions
- opportunities to practise and demonstrate growth and achievement
- elements of risk and challenge provided in a safe environment
- consideration of, and for, past related experiences
- time allocation
- teacher willingness and expertise
- diversity of instructional strategies
- focus on outcomes rather than dimensions
- facilities and equipment resources
- use of community resources
- use of technology
- assessment, evaluation and communication of student learning
- transference to lifelong participation in physical activity.

Exemptions

To meet the aim of the program it is recommended that a variety of movement experiences be provided in all the dimensions. In the following specified circumstances; however, exemptions may be warranted from one or more dimensions and/or a physical education course.

Category	Conditions for Exemption	Procedures	Other Experiences
INDIVIDUAL	Religious beliefs	• Statement in writing from parent to principal.	• When exemption is granted, other activities consistent with the aim and outcomes of the program should be substituted, where appropriate.
INDIVIDUAL	Medical	• Certification to principal by medical practitioner with statement of activities in which the student is not able to participate.	
CLASS, GRADE OR SCHOOL	Access to facilities	• Initiated by school authority or parent. • Approved by school authority.	

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B. GENERAL AND SPECIFIC OUTCOMES

The four **general outcomes** upon which the Kindergarten to Grade 12 physical education program is based state that *students will*:

Activity

- acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits

Benefits Health

- understand, experience and appreciate the health benefits that result from physical activity

Cooperation

- interact positively with others

Do it Daily ... for Life!

- assume responsibility to lead an active way of life.

The general outcomes are interrelated and interdependent. Each is to be achieved through a variety of physical activities. Students must have the opportunity for participation in each of the following dimensions:

- dance
- games
- types of gymnastics
- individual activities
- activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Each general outcome includes **specific outcomes**, by grade, and at the senior high school level by course name. Students are expected to demonstrate these outcomes, to the best of their ability, by the end of each grade/course.

Program planning requires consideration of student age, grade level, individual abilities and developmental readiness. Assessment, evaluation and communication of student achievement requires consideration of such factors as practice time, individual growth and development, and overall improvement.

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GENERAL OUTCOMES

The aim of the Kindergarten to Grade 12 physical education program is to enable individuals to develop the knowledge, skills and attitudes necessary to lead an active, healthy lifestyle.

General Outcome A

***Students will* acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.**

- Basic Skills; Locomotor; Nonlocomotor; Manipulative
- Application of Basic Skills in an Alternative Environment; i.e., Aquatics and Outdoor Pursuits; Dance, Games, Types of Gymnastics, Individual Activities

General outcomes B, C and D are interrelated and interdependent and are achieved through involvement in movement activities identified in General Outcome A.

General Outcome B

***Students will* understand, experience and appreciate the health benefits that result from physical activity.**

- Functional Fitness
- Body Image
- Well-being

General Outcome C

***Students will* interact positively with others.**

- Communication
- Fair Play
- Leadership
- Teamwork

General Outcome D

***Students will* assume responsibility to lead an active way of life.**

- Effort
- Safety
- Goal Setting/Personal Challenge
- Active Living in the Community

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SPECIFIC OUTCOMES

GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Kindergarten [AK–]	Grade 1 [A1–]	Grade 2 [A2–]	Grade 3 [A3–]

Students will:

Basic Skills—Locomotor; e.g., walking, running, hopping, jumping, leaping, rolling, skipping, galloping, climbing, sliding, propulsion through water

AK–1	experience and develop locomotor skills through a variety of activities	A1–1	perform locomotor skills through a variety of activities	A2–1	select and perform locomotor skills involved in a variety of activities	A3–1	respond to a variety of stimuli to create locomotor sequences
AK–2	N/A	A1–2	N/A	A2–2	N/A	A3–2	N/A

Basic Skills—Nonlocomotor; e.g., turning, twisting, swinging, balancing, bending, landing, stretching, curling, hanging

AK–3	experience and develop nonlocomotor skills through a variety of activities	A1–3	perform nonlocomotor skills through a variety of activities	A2–3	select and perform nonlocomotor skills involved in a variety of activities	A3–3	respond to a variety of stimuli to create nonlocomotor sequences
AK–4	N/A	A1–4	N/A	A2–4	N/A	A3–4	N/A

Basic Skills—Manipulative: receiving; e.g., catching, collecting; retaining: e.g., dribbling, carrying, bouncing, trapping: sending; e.g., throwing, kicking, striking

AK–5	experience and develop ways to receive, retain and send an object, using a variety of body parts and implements and through a variety of activities	A1–5	demonstrate ways to receive, retain and send an object, using a variety of body parts and implements, individually and with others	A2–5	select and perform ways to receive, retain and send an object, using a variety of body parts and implements, individually and with others	A3–5	demonstrate ways to receive, retain and send an object, using a variety of body parts and implements; and, perform manipulative skills individually and with others while using a variety of pathways
AK–6	N/A	A1–6	N/A	A2–6	N/A	A3–6	N/A

All outcomes are achieved through active and safe participation in physical education.

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Activity

GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Grade 4 [A4–]	Grade 5 [A5–]	Grade 6 [A6–]

Students will:

Basic Skills—Locomotor; e.g., walking, running, hopping, jumping, leaping, rolling, skipping, galloping, climbing, sliding, propulsion through water

A4–1 select, perform and refine simple locomotor sequences	A5–1 select, perform and refine more challenging locomotor sequences	A6–1 select, perform and refine challenging locomotor sequences
A4–2 consistently and confidently perform locomotor skills and combination of skills, by using elements of body and space awareness, effort and relationships to a variety of stimuli to improve personal performance	A5–2 consistently and confidently perform locomotor skills and combination of skills, by using elements of body and space awareness, effort and relationships to a variety of stimuli to improve personal performance	A6–2 consistently and confidently perform locomotor skills and combination of skills, by using elements of body and space awareness, effort and relationships, alone and with others, to improve personal performance

Basic Skills—Nonlocomotor; e.g., turning, twisting, swinging, balancing, bending, landing, stretching, curling, hanging

A4–3 select, perform and refine simple nonlocomotor sequences	A5–3 select, perform and refine more challenging nonlocomotor sequences	A6–3 select, perform and refine challenging nonlocomotor sequences
A4–4 consistently and confidently perform nonlocomotor skills by using elements of body and space awareness, effort and relationships to a variety of stimuli to improve personal performance	A5–4 consistently and confidently perform nonlocomotor skills by using elements of body and space awareness, effort and relationships to a variety of stimuli to improve personal performance	A6–4 consistently and confidently perform nonlocomotor skills by using elements of body and space awareness, effort and relationships, to improve personal performance

Basic Skills—Manipulative: receiving; e.g., catching, collecting: retaining; e.g., dribbling, carrying, bouncing, trapping: sending; e.g., throwing, kicking, striking

A4–5 select, perform and refine ways to receive, retain and send an object with control	A5–5 select, perform and refine more challenging ways to receive, retain and send an object with control	A6–5 demonstrate ways to receive, retain and send an object with increasing accuracy
A4–6 consistently and confidently perform manipulative skills by using elements of body and space awareness, effort and relationship	A5–6 consistently and confidently perform manipulative skills by using elements of body and space awareness, effort and relationship	A6–6 consistently and confidently perform manipulative skills by using elements of body and space awareness, effort and relationship

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Activity

GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Grade 7 [A7–]	Grade 8 [A8–]	Grade 9 [A9–]
Students will:		
Basic Skills—Locomotor; e.g., walking, running, hopping, jumping, leaping, rolling, skipping, galloping, climbing, sliding, propulsion through water		
A7–1 demonstrate ways to improve and refine the functional and expressive quality of locomotor skills to improve personal performance	A8–1 select, combine and perform specific locomotor skills in a variety of activities to improve personal performance	A9–1 apply and refine locomotor skills and concepts to a variety of activities with increased control to improve personal performance
A7–2 demonstrate locomotor skills by using elements of body and space awareness, effort and relationships to improve personal performance	A8–2 select, combine and perform locomotor skills by using elements of body and space awareness, effort and relationships to improve personal performance	A9–2 apply and refine locomotor skills by using elements of body and space awareness, effort and relationships to improve personal performance
Basic Skills—Nonlocomotor; e.g., turning, twisting, swinging, balancing, bending, landing, stretching, curling, hanging		
A7–3 demonstrate ways to improve and refine the functional and expressive quality of nonlocomotor skills to improve personal performance	A8–3 select, combine and perform specific nonlocomotor skills in a variety of activities to improve personal performance	A9–3 apply and refine nonlocomotor skills and concepts to a variety of activities with increased control to improve personal performance
A7–4 demonstrate nonlocomotor skills by using elements of body and space awareness, effort and relationships, to improve personal performance	A8–4 select, combine and perform nonlocomotor skills by using elements of body and space awareness, effort and relationships, to improve personal performance	A9–4 apply and refine nonlocomotor skills by using elements of body and space awareness, effort and relationships, to improve personal performance
Basic Skills—Manipulative: receiving; e.g., catching, collecting: retaining; e.g., dribbling, carrying, bouncing, trapping: sending; e.g., throwing, kicking, striking		
A7–5 demonstrate ways to receive, retain and send an object with varying speeds and accuracy in skills specific to an activity	A8–5 demonstrate ways to receive, retain and send an object with varying speeds, accuracy and distance in skills specific to an activity	A9–5 apply and refine ways to receive, retain and send an object with increased speed, accuracy and distance in skills specific to an activity
A7–6 demonstrate manipulative skills by using elements of space awareness, effort and relationships, with and without objects, to improve performance	A8–6 select, combine and perform manipulative skills by using elements of space awareness, effort and relationships, with and without objects, to improve performance	A9–6 apply and refine manipulative skills by using elements of space awareness, effort and relationships, with and without objects, to improve performance

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Activity

GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Physical Education 10 [A10–]	Physical Education 20 [A20–]	Physical Education 30 [A30–]

Students will:

Basic Skills—Locomotor; e.g., walking, running, hopping, jumping, leaping, rolling, skipping, galloping, climbing, sliding, propulsion through water

A10–1	apply and refine locomotor skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance	A20–1	analyze, evaluate and modify performance of locomotor skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance	A30–1	analyze, evaluate and adapt performance of locomotor skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance
A10–2	N/A	A20–2	N/A	A30–2	N/A

Basic Skills—Nonlocomotor; e.g., turning, twisting, swinging, balancing, bending, landing, stretching, curling, hanging

A10–3	apply and refine nonlocomotor skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance	A20–3	analyze, evaluate and modify performance of nonlocomotor skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance	A30–3	analyze, evaluate and adapt performance of nonlocomotor skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance
A10–4	N/A	A20–4	N/A	A30–4	N/A

Basic Skills—Manipulative: receiving; e.g., catching, collecting: retaining; e.g., dribbling, carrying, bouncing, trapping: sending; e.g., throwing, kicking, striking

A10–5	apply and refine manipulative skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance	A20–5	analyze, evaluate and modify performance of manipulative skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance	A30–5	analyze, evaluate and adapt performance of manipulative skills and concepts—effort, space and relationships—to perform and create a variety of activities to improve personal performance
A10–6	N/A	A20–6	N/A	A30–6	N/A

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Activity

GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Kindergarten [AK–]	Grade 1 [A1–]	Grade 2 [A2–]	Grade 3 [A3–]
Students will:			
Application of Basic Skills in an Alternative Environment			
AK–7 experience the basic skills in a variety of environments; e.g., playground	A1–7 demonstrate the basic skills in a variety of environments; e.g., tarmac activities	A2–7 select and perform basic skills in a variety of environments and using various equipment; e.g., obstacle course	A3–7 select and perform basic skills in a variety of environments and using various equipment; e.g., snowshoeing
Application of Basic Skills in Dance			
AK–8 experience movement to respond to a variety of stimuli; e.g., music	A1–8 perform simple movements by using elements of effort and space to respond to a variety of stimuli; e.g., music	A2–8 demonstrate basic dance steps and movement; e.g., creative, folk, line, sequence and novelty, alone and with others, by using elements of effort, space and relationship	A3–8 select and perform basic dance steps and patterns; e.g., creative, folk, line, sequence and novelty, alone and with others
AK–9 experience body awareness when performing dance activities	A1–9 demonstrate body awareness when performing dance activities	A2–9 perform simple movement sequences by using elements of body and space awareness and relationships, alone and with others	A3–9 select and perform simple movement sequences by using elements of body and space awareness and relationships, alone and with others
Application of Basic Skills in Games			
AK–10 demonstrate body and space awareness when performing space awareness games	A1–10 demonstrate body and space awareness when performing space awareness games	A2–10 create and play body and space awareness games	A3–10 perform and play lead-up games and demonstrate elements of space awareness, effort and relationship
AK–11 demonstrate an understanding of basic rules and fair play	A1–11 demonstrate an understanding of basic rules and fair play for simple games	A2–11 apply basic rules and fair play while playing and learning the strategies of lead-up games	A3–11 demonstrate the ability to work together with a teammate/team to achieve a common activity goal while playing and learning the basic strategies of lead-up games

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Activity

GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Grade 4 [A4–]	Grade 5 [A5–]	Grade 6 [A6–]
Students will:		
Application of Basic Skills in an Alternative Environment		
A4–7 select, perform and refine basic skills in a variety of environments and using various equipment; e.g., water safety, skating, swimming	A5–7 select, perform and refine more challenging basic skills in a variety of environments and using various equipment; e.g., cross-country skiing, orienteering	A6–7 select, perform and refine more challenging basic skills in a variety of environments and using various equipment; e.g., downhill skiing, hiking
Application of Basic Skills in Dance		
A4–8 select, perform and refine basic dance steps and patterns; e.g., creative, folk, line, sequence and novelty, alone and with others	A5–8 demonstrate a variety of dances; e.g., creative, folk, line, sequence and novelty, alone and with others	A6–8 demonstrate and refine a variety of dances; e.g., creative, folk, line, square and novelty, alone and with others
A4–9 demonstrate a creative process to develop dance sequences alone and with others	A5–9 demonstrate a creative process to develop dance sequences alone and with others; and, demonstrate movement sequences in response to a variety of musical, verbal and visual stimuli	A6–9 demonstrate a creative process to develop dance sequences alone and with others; and, demonstrate movement sequences in response to a variety of musical, verbal and visual stimuli
Application of Basic Skills in Games		
A4–10 demonstrate critical thinking and problem-solving skills to modify games and achieve activity outcomes	A5–10 apply critical thinking and problem-solving skills to create competitive and cooperative modified games that involve everyone	A6–10 demonstrate sport specific skills to create competitive and cooperative modified games that involve everyone
A4–11 demonstrate strategies and tactics that coordinate effort with others; e.g., team, in order to achieve a common activity goal in lead-up games	A5–11 demonstrate basic strategies and tactics that coordinate effort with others; e.g., team, in order to achieve a common activity goal in lead-up games	A6–11 demonstrate basic strategies and tactics that coordinate effort with others; e.g., team, in order to achieve a common activity goal and moving toward more formal games

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GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Grade 7 [A7–]	Grade 8 [A8–]	Grade 9 [A9–]
Students will:		
Application of Basic Skills in an Alternative Environment		
A7–7 demonstrate activity-specific skills in a variety of environments and using various equipment; e.g., orienteering	A8–7 apply activity-specific skills in a variety of environments and using various equipment; e.g., cross-country skiing, skating	A9–7 apply and refine activity-specific skills in a variety of environments; e.g., hiking, wall climbing
Application of Basic Skills in Dance		
A7–8 refine and present a variety of dance sequences; e.g., folk, square, social and novelty, alone and with others	A8–8 select, refine and present a variety of dance sequences; e.g., jazz, square, social and novelty, alone and with others	A9–8 create, refine and present a variety of dance sequences; e.g., jazz, square, social and novelty, alone and with others
A7–9 choreograph and perform dance sequences, using the elements of movement and basic dance steps and patterns	A8–9 choreograph and perform dance sequences, using the elements of movement and basic dance steps and patterns	A9–9 choreograph and perform dance sequences, using the elements of movement and basic dance steps and patterns
Application of Basic Skills in Games		
A7–10 demonstrate activity-specific basic skills in a variety of games	A8–10 select, combine and perform activity-specific basic skills in a variety of games	A9–10 apply and refine activity-specific basic skills in a variety of games
A7–11 demonstrate more challenging strategies and tactics that coordinate effort with others; e.g., team/fair play, in order to achieve a common goal activity	A8–11 be able to identify and evaluate specific strategies and tactics that coordinate effort with others; e.g., team/fair play, in order to achieve a common activity goal	A9–11 create and plan activities that emphasize specific strategies and tactics that coordinate effort with others; e.g., team/fair play, in order to achieve a common activity goal

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GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Physical Education 10 [A10–]	Physical Education 20 [A20–]	Physical Education 30 [A30–]
Students will:		
Application of Basic Skills in an Alternative Environment		
A10–7 adapt and improve activity-specific skills in a variety of environments; e.g., camping, canoeing, survival skills	A20–7 develop and combine more challenging activity-specific skills in a variety of environments; e.g., snorkelling progressing to scuba diving	A30–7 recommend and relate a choice of activity-specific skills in an alternative environment to meet activity goal; e.g., river canoeing versus flat water canoeing
Application of Basic Skills in Dance		
A10–8 apply the principles of dance to improve performance	A20–8 develop and perform more complex dances	A30–8 develop, refine and perform more complex dances
A10–9 choreograph and perform dances for self and others; e.g., jazz, social and novelty	A20–9 choreograph, perform and interpret dance for self and others; e.g., jazz, social and novelty	A30–9 choreograph, perform and critique dance for self and others; e.g., jazz, social and novelty
Application of Basic Skills in Games		
A10–10 adapt and improve activity-specific skills in a variety of games	A20–10 develop and refine activity-specific skills in a variety of games	A30–10 develop and further refine activity-specific skills in a variety of games
A10–11 select, plan and create games that incorporate simple and more challenging strategies and tactics	A20–11 apply the relationship among skills, rules and strategies in the creation and playing of games	A30–11 apply and analyze the relationship among skills, rules and strategies in the creation and playing of games

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Activity

GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Kindergarten [AK–]	Grade 1 [A1–]	Grade 2 [A2–]	Grade 3 [A3–]

Students will:

Application of Basic Skills in Types of Gymnastics

AK–12 experience educational gymnastics; e.g., exploring the use of different body parts, types of effort, space and relationships	A1–12 demonstrate the basic skills in educational gymnastics; e.g., use of different body parts, types of effort, space and relationships	A2–12 select and perform the basic skills in educational gymnastics; e.g., use of different body parts, types of effort, space and relationships, to develop a sequence	A3–12 select and perform the basic skills in educational gymnastics; e.g., use of different body parts, types of effort, space and relationships to develop a sequence

Application of Basic Skills in Individual Activities

AK–13 experience the basic skills of running, jumping, throwing in a variety of environments; e.g., field	A1–13 demonstrate the basic skills of running, jumping, throwing in a variety of environments and using various equipment; e.g., skipping ropes	A2–13 select and perform basic skills of running, jumping, throwing in a variety of environments and using various equipment; e.g., catching	A3–13 manipulate a variety of small objects while performing basic skills to demonstrate personal control; e.g., juggling

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GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Grade 4 [A4–]	Grade 5 [A5–]	Grade 6 [A6–]

Students will:

Application of Basic Skills in Types of Gymnastics

A4–12 select, perform and refine the basic skills in educational gymnastics, e.g., use of different body parts, types of effort, space and relationships to develop a sequence	A5–12 apply and refine basic skills and elements of body and space awareness, effort and relationships together to form a variety of more challenging gymnastic sequences individually, with a partner, or in a group; e.g., educational, rhythmic gymnastics	A6–12 select, perform and refine basic skills and elements of body and space awareness, effort and relationships together to form a variety of more challenging gymnastic sequences individually, with a partner, or in a group; e.g., educational, rhythmic gymnastics

Application of Basic Skills in Individual Activities

A4–13 select, perform and refine basic skills in individual activities; e.g., cross country running	A5–13 select, perform and refine more challenging basic skills in individual activities; e.g., hacky sack	A6–13 demonstrate activity specific skills in a variety of individual activities; e.g., track and field/ athletics

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GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Grade 7 [A7–]	Grade 8 [A8–]	Grade 9 [A9–]

Students will:

Application of Basic Skills in Types of Gymnastics

A7–12 demonstrate ways to improve and refine the functional and expressive qualities of movements that combine basic skills in a variety of gymnastic experiences individually, with a partner, or in a group; e.g., educational, rhythmic and artistic	A8–12 select and perform ways to improve the functional and expressive qualities of movements, that combine basic skills in a variety of gymnastic experiences individually, with a partner, or in a group; e.g., educational, rhythmic and artistic	A9–12 apply and refine ways to improve the functional and expressive qualities of movements, that combine basic skills in a variety of gymnastic experiences individually, with a partner, or in a group; e.g., educational, rhythmic and artistic

Application of Basic Skills in Individual Activities

A7–13 demonstrate activity-specific skills in a variety of individual pursuits; e.g., power walk	A8–13 select, perform and refine activity-specific skills in a variety of individual pursuits; e.g. wrestling	A9–13 apply and refine activity-specific skills in a variety of individual pursuits; e.g., fitness activities

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GENERAL OUTCOME A

Students will acquire skills through a variety of developmentally appropriate movement activities; dance, games, types of gymnastics, individual activities and activities in an alternative environment; e.g., aquatics and outdoor pursuits.

Physical Education 10	Physical Education 20	Physical Education 30
Students will:		
Application of Basic Skills in Types of Gymnastics		
A10–12 apply the basic skills in combination with each other with personal proficiency in a variety of gymnastic experiences individually, with a partner, or in a group; e.g., educational, rhythmic and artistic	A20–12 apply a combination of the basic skills in a variety of gymnastic and movement experiences individually, with a partner, or in a group	A30–12 refine and transfer the basic skills in a variety of gymnastic and movement experiences individually, with a partner, or in a group
Application of Basic Skills in Individual Activities		
A10–13 adapt and improve activity-specific skills in a variety of individual pursuits; e.g., resistance training, aerobics	A20–13 develop and combine more challenging activity-specific skills in a variety of individual pursuits; e.g., self-defense	A30–13 recommend a choice of activity-specific skills in pursuing lifelong individual activities; e.g., cycling

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GENERAL OUTCOME B

Students will understand, experience and appreciate the health benefits that result from physical activity.

Kindergarten [BK–]	Grade 1 [B1–]	Grade 2 [B2–]	Grade 3 [B3–]
Students will:			
Functional Fitness			
BK–1 recognize appropriate nutritional habits	B1–1 identify healthy nutritional habits	B2–1 recognize that "energy" is required for muscle movement	B3–1 describe the concept of energy required for muscles
BK–2 recognize improvement in physical abilities	B1–2 demonstrate ways to improve personal growth in physical abilities	B2–2 describe ways to improve personal growth in physical abilities	B3–2 demonstrate and describe ways to improve personal growth in physical abilities
BK–3 experience cardio-respiratory activities	B1–3 experience and improve continued frequency of involvement in cardio-respiratory activities	B2–3 experience movement involving the components of health-related fitness; e.g., flexibility, endurance, strength, cardio-respiratory activities	B3–3 experience movement involving the components of health-related fitness; e.g., flexibility, endurance, strength, cardio-respiratory activities
Body Image			
BK–4 recognize personal abilities while participating in physical activity	B1–4 recognize personal abilities while participating in physical activity	B2–4 identify personal physical attributes that contribute to physical activity	B3–4 describe personal physical attributes that contribute to physical activity
BK–5 N/A	B1–5 N/A	B2–5 N/A	B3–5 N/A
Well-being			
BK–6 experience how physical activity makes one feel	B1–6 describe how physical activity makes you feel	B2–6 describe how the body benefits from physical activity	B3–6 describe the benefits of physical activity to the body
BK–7 experience the changes that take place in the body during physical activity	B1–7 recognize the changes that take place in the body during physical activity	B2–7 identify changes that take place in the body during physical activity	B3–7 describe the changes that take place in the body during physical activity
BK–8 understand the connections between physical activity and emotional well-being; e.g., feels good	B1–8 understand the connections between physical activity and emotional well-being; e.g., feels good	B2–8 understand the connections between physical activity and emotional well-being; e.g., feels good	B3–8 understand the connections between physical activity and emotional well-being; e.g., feels good

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GENERAL OUTCOME B

Students will understand, experience and appreciate the health benefits that result from physical activity.

Grade 4 [B4–]	Grade 5 [B5–]	Grade 6 [B6–]
Students will:		
Functional Fitness		
B4–1 identify the nutritional needs related to physical activity	B5–1 explain the relationship between nutritional habits and physical activity	B6–1 explain the relationship between nutritional habits and performance in physical activity
B4–2 demonstrate and describe ways to achieve a personal functional level of physical fitness through participation in physical activity	B5–2 demonstrate and select ways to achieve a personal functional level of physical fitness through participation in physical activity	B6–2 demonstrate and select ways to achieve a personal functional level of physical fitness through participation in physical activity
B4–3 experience movement, involving components of fitness	B5–3 identify and explain the importance of the components of fitness to health and well-being; e.g., strength, endurance, flexibility, cardio-respiratory activities	B6–3 explain the components of fitness; e.g., strength, endurance, flexibility, cardio-respiratory activities, and relate these to personal fitness level
Body Image		
B4–4 recognize and personally acknowledge individual and other attributes that contribute to physical activity	B5–4 acknowledge and accept individual differences in body shapes and how different body types contribute to positive involvement in physical activities	B6–4 acknowledge and accept individual differences in body shapes and how different body types contribute to positive involvement in physical activities
B4–5 N/A	B5–5 N/A	B6–5 N/A
Well-being		
B4–6 describe positive benefits gained from physical activity; e.g., physically, emotionally, socially	B5–6 infer positive benefits gained from specific physical activities	B6–6 identify and plan for personal positive benefits from specific physical activity
B4–7 demonstrate changes that take place in the body during physical activity	B5–7 describe how physical activity influences physical fitness and the body systems	B6–7 describe and chart individual fitness changes as a result of engaging in physical activity
B4–8 understand the connection between physical activity, stress management and relaxation	B5–8 understand the connection between physical activity, stress management and relaxation	B6–8 understand the connection between physical activity, stress management and relaxation

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GENERAL OUTCOME B

Students will understand, experience and appreciate the health benefits that result from physical activity.

Grade 7 [B7–]	Grade 8 [B8–]	Grade 9 [B9–]
Students will:		
Functional Fitness		
B7–1 analyze personal nutritional habits and how they relate to performance in physical activity	B8–1 monitor and analyze a personal nutrition plan that affects physical performance	B9–1 design, monitor and personally analyze nutrition programs that will affect physical performance
B7–2 demonstrate and evaluate ways to achieve a personal functional level of physical fitness	B8–2 demonstrate and monitor ways to achieve a personal functional level of physical fitness	B9–2 demonstrate, monitor and analyze ways to achieve a personal functional level of physical fitness
B7–3 explain the components of fitness; e.g., strength, endurance, flexibility, cardio-respiratory activity; analyze individual abilities and formulate an individual plan for growth	B8–3 explain fitness components and principles of training, and formulate individual plans for personal physical fitness	B9–3 design and implement a personal fitness and activity plan, using the principles of training: frequency intensity, duration
Body Image		
B7–4 identify different body types and how all types can contribute to, or participate positively in, physical activity	B8–4 acknowledge the perceptions that occur as a result of media influence on body types in relation to physically active images	B9–4 acknowledge and analyze the media and peer influences on body image
B7–5 discuss performance-enhancing substances as a part of the negative effect on physical activity	B8–5 discuss performance-enhancing substances and how they can affect body type in relation to physical activity	B9–5 discuss the effects of performance-enhancing substances on body type and body image as a part of physical activity
Well-being		
B7–6 identify and explain the effects of exercise on the body systems before, during and after exercise	B8–6 analyze the personal effects of exercise on the body systems before, during and after exercise	B9–6 analyze and explain the effects that nutrition, fitness and physical activity have on body systems before, during and after exercise
B7–7 interpret personal fitness changes as a result of physical activity	B8–7 monitor, analyze and assess fitness changes as a result of physical activity	B9–7 monitor, analyze and assess fitness changes as a result of physical activity
B7–8 understand the connection between physical activity, stress management and relaxation	B8–8 describe and perform appropriate physical activities for personal stress management and relaxation	B9–8 select and perform appropriate physical activities for personal stress management and relaxation

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GENERAL OUTCOME B

Students will understand, experience and appreciate the health benefits that result from physical activity.

Physical Education 10 [B10–]	Physical Education 20 [B20–]	Physical Education 30 [B30–]
Students will:		
Functional Fitness		
B10–1 design, analyze and modify nutrition programs that will positively affect performance in physical activity	B20–1 compare and contrast different nutrition programs that will positively affect performance in physical activity; e.g., pre- and post-competition	B30–1 design and justify nutrition plans that will positively affect performance for a variety of physical activities; e.g., triathlon training versus fitness maintenance
B10–2 demonstrate, monitor, analyze and reflect upon ways to achieve a personal functional level of physical fitness	B20–2 add to the variety of ways for achieving a personal functional fitness level	B30–2 appraise different activities and their effects on a personal functional level of fitness
B10–3 plan, assess and maintain personal fitness, using the principles of training: frequency, intensity, duration	B20–3 plan, assess and maintain personal fitness, using the principles of training: progression, overload and specificity	B30–3 evaluate, monitor and adapt fitness plans for self and others, applying the principles of training
Body Image		
B10–4 acknowledge and analyze the media and peer influences on body image	B20–4 interpret the impact of the media and peer influences on body image	B30–4 interpret and evaluate the impact of the media and peer influences on body image
B10–5 discuss the effects of performance-enhancing substances on body type and body image as a part of physical activity	B20–5 discuss the effects of performance-enhancing substances on body type and body image as a part of physical activity	B30–5 discuss the effects of performance-enhancing substances on body type and body image as a part of physical activity
Well-being		
B10–6 clarify the positive benefits that occur as a result of participation in physical activity	B20–6 analyze the positive benefits gained from physical activity	B30–6 predict the positive benefits gained from physical activity
B10–7 understand the consequences and risks associated with an inactive lifestyle; e.g., the benefits of a healthy heart versus the need for emergency cardiac care (CPR)	B20–7 understand the consequences and risks associated with an inactive lifestyle	B30–7 understand the consequences and risks associated with an inactive lifestyle
B10–8 select and perform appropriate physical activities for personal stress management and relaxation	B20–8 design and implement a plan for personal stress management	B30–8 monitor and evaluate the plan for personal stress management

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GENERAL OUTCOME C

Students will interact positively with others.

Kindergarten [CK–]	Grade 1 [C1–]	Grade 2 [C2–]	Grade 3 [C3–]
Students will:			
Communication			
CK–1 begin to develop respectful communication skills appropriate to context	C1–1 develop and demonstrate respectful communication skills appropriate to context	C2–1 identify and demonstrate respectful communication skills appropriate to context	C3–1 describe and demonstrate respectful communication skills appropriate to context
CK–2 N/A	C1–2 N/A	C2–2 N/A	C3–2 N/A
Fair Play			
CK–3 identify and demonstrate etiquette and fair play	C1–3 identify and demonstrate etiquette and fair play	C2–3 identify and demonstrate etiquette and fair play	C3–3 identify and demonstrate etiquette and fair play
Leadership			
CK–4 experience different roles in a variety of physical activities	C1–4 identify different roles in a variety of physical activities	C2–4 accept responsibility for assigned roles while participating in physical activity	C3–4 accept responsibility for assigned roles while participating in physical activity
Teamwork			
CK–5 display a willingness to play alongside others	C1–5 display a willingness to play cooperatively with others in large and small groups	C2–5 display a willingness to play cooperatively with others of various abilities, in large or small groups	C3–5 display a willingness to share ideas, space and equipment when participating cooperatively with others
CK–6 N/A	C1–6 N/A	C2–6 N/A	C3–6 N/A

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GENERAL OUTCOME C

Students will interact positively with others.

Grade 4 [C4–]	Grade 5 [C5–]	Grade 6 [C6–]
Students will:		
Communication		
C4–1 articulate and demonstrate respectful communication skills appropriate to context	C5–1 identify and demonstrate respectful communication skills appropriate to cooperative participation in physical activity	C6–1 identify and demonstrate respectful communication skills appropriate to various physical activities and that reflect feelings, ideas and experiences
C4–2 N/A	C5–2 N/A	C6–2 N/A
Fair Play		
C4–3 identify and demonstrate etiquette and fair play	C5–3 demonstrate etiquette and fair play	C6–3 demonstrate etiquette and fair play
Leadership		
C4–4 select and demonstrate responsibility for assigned roles while participating in physical activity; and, accept ideas from others that relate to changing/adapting, movement experiences	C5–4 select and demonstrate responsibility for various roles while participating in physical education; and, accept ideas from others that relate to changing/adapting, movement experiences	C6–4 identify and then take responsibility for various roles while participating in physical activity; and, identify leadership and followership skills used while participating in physical education
Teamwork		
C4–5 participate cooperatively in group activities	C5–5 identify and demonstrate practices that contribute to teamwork	C6–5 describe and demonstrate practices that contribute to teamwork
C4–6 identify and demonstrate positive behaviours that show respect for self and others	C5–6 identify and demonstrate positive behaviours that show respect for self and others	C6–6 identify and demonstrate positive behaviours that show respect for self and others

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GENERAL OUTCOME C

Students will interact positively with others.

Grade 7 [C7–]	Grade 8 [C8–]	Grade 9 [C9–]
Students will:		
Communication		
C7–1 communicate thoughts and feelings in an appropriate respectful manner as they relate to participation in physical activity	C8–1 communicate thoughts and feelings in an appropriate respectful manner as they relate to participation in physical activity	C9–1 communicate thoughts and feelings in an appropriate respectful manner as they relate to participation in physical activity
C7–2 identify positive active living role models	C8–2 discuss positive active living role models	C9–2 identify and discuss the positive behaviours that are demonstrated by active living role models
Fair Play		
C7–3 demonstrate etiquette and fair play	C8–3 demonstrate etiquette and fair play	C9–3 demonstrate etiquette and fair play
Leadership		
C7–4 identify and then take responsibility for various roles while participating in physical activity; and, identify the leadership and followership skills used while participating in physical education	C8–4 describe, apply and practise leadership and followership skills related to physical activity	C9–4 describe, apply, monitor and practise leadership and followership skills related to physical activity
Teamwork		
C7–5 select and apply practices that contribute to teamwork	C8–5 recommend practices that contribute to teamwork	C9–5 develop practices that contribute to teamwork
C7–6 identify and demonstrate positive behaviours that show respect for self and others	C8–6 identify and demonstrate positive behaviours that show respect for self and others	C9–6 identify and demonstrate positive behaviours that show respect for self and others

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GENERAL OUTCOME C

Students will interact positively with others.

Physical Education 10 [C10–]	Physical Education 20 [C20–]	Physical Education 30 [C30–]
Students will:		
Communication		
C10–1 communicate thoughts and feelings in an appropriate respectful manner as they relate to participation in physical activity	C20–1 communicate thoughts and feelings in an appropriate respectful manner as they relate to participation in physical activity	C30–1 communicate thoughts and feelings in an appropriate respectful manner as they relate to participation in physical activity
C10–2 discuss issues related to positive athletic/active living role models	C20–2 demonstrate an understanding of behaviour appropriate to positive active living role modelling	C30–2 discuss issues related to active living
Fair Play		
C10–3 demonstrate etiquette and fair play	C20–3 demonstrate etiquette and fair play	C30–3 demonstrate etiquette and fair play
Leadership		
C10–4 describe, apply, monitor and assess leadership and followership skills related to physical activity	C20–4 apply, monitor and assess leadership and followership skills related to physical activities, and demonstrate an understanding of leadership skills related to implementing physical activity events or programs in the school and/or community	C30–4 apply, monitor and assess leadership and followership skills related to physical activities, and demonstrate an understanding of leadership skills related to implementing physical activity events or programs in the school and/or community
Teamwork		
C10–5 develop and apply practices that contribute to teamwork	C20–5 develop and apply practices that contribute to teamwork	C30–5 develop and apply practices that contribute to teamwork
C10–6 identify and demonstrate positive behaviours that show respect for self and others	C20–6 identify and demonstrate positive behaviours that show respect for self and others	C30–6 identify and demonstrate positive behaviours that show respect for self and others

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Do it Daily ... for Life!

GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Kindergarten [DK–]	Grade 1 [D1–]	Grade 2 [D2–]	Grade 3 [D3–]
Students will:			
Effort			
DK–1 show a willingness to participate regularly in short periods of activity with frequent rest intervals	D1–1 show a willingness to participate regularly in short periods of activity with frequent rest intervals	D2–1 express a willingness to participate regularly in physical education class	D3–1 express a willingness to participate regularly in physical education class
DK–2 participate with effort in physical activities	D1–2 demonstrate effort while participating in various activities	D2–2 identify personal factors that encourage movement	D3–2 describe factors that encourage movement and a personal feeling about movement
Safety			
DK–3 show a willingness to listen to directions and simple explanations	D1–3 show a willingness to listen to directions and simple explanations	D2–3 demonstrate the ability to listen to directions, follow rules and routines, and stay on-task while participating in physical activity	D3–3 demonstrate the ability to listen to directions, follow rules and routines, and stay on task while participating in physical activity
DK–4 participate in safe warm-up and cool-down activities	D1–4 participate in safe warm-up and cool-down activities	D2–4 demonstrate and participate in safe warm-up and cool-down activities	D3–4 demonstrate and participate in safe warm-up and cool-down activities
DK–5 experience moving safely and sensitively through all environments; e.g., movement activities	D1–5 move safely and sensitively through all environments; e.g., space awareness activities	D2–5 demonstrate moving safely and sensitively in various environments; e.g., modified games	D3–5 tell about safe movement experiences in various environments; e.g., gymnastic equipment

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Do it Daily ... for Life!

GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Grade 4 [D4–1]	Grade 5 [D5–]	Grade 6 [D6–]
Students will:		
Effort		
D4–1 demonstrate a willingness to participate regularly in physical education class	D5–1 participate regularly in physical activity to develop components of health-related fitness and movement skills	D6–1 demonstrate enjoyment of participation through extended effort in physical activity
D4–2 demonstrate factors that encourage movement	D5–2 demonstrate factors that encourage movement	D6–2 identify and demonstrate strategies that encourage participation and continued motivation
Safety		
D4–3 follow rules, routines and procedures for safety in a variety of activities	D5–3 identify and follow rules, routines and procedures for safety in a variety of activities	D6–3 identify, describe and follow the rules, routines and procedures for safety in a variety of activities from all movement dimensions
D4–4 participate in, and identify the benefits of, safe warm-up and cool-down activities	D5–4 participate in, and identify the benefits of, safe warm-up and cool-down activities	D6–4 participate in, and demonstrate the benefits of, safe warm-up and cool-down activities
D4–5 describe how to move safely in various environments; e.g., skating rink	D5–5 identify safe practices that promote an active, healthy lifestyle; e.g., water safety	D6–5 select simple, safe practices that promote an active, healthy lifestyle; e.g., rules of the road for cycling, inline skating

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GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Grade 7 [D7–]	Grade 8 [D8–]	Grade 9 [D9–]
Students will:		
Effort		
D7–1 participate regularly in, and identify the benefits of, an active lifestyle	D8–1 participate regularly in, and identify and describe the benefits of, an active lifestyle	D9–1 participate regularly in, and realize the benefits of, an active lifestyle
D7–2 identify and demonstrate strategies that encourage participation and continued motivation	D8–2 develop a personal plan that encourages participation and continued motivation	D9–2 develop a personal plan that encourages participation and continued motivation
Safety		
D7–3 identify, describe and follow the rules, routines and procedures for safety in a variety of activities in all dimensions	D8–3 select and apply rules, routines and procedures for safety in a variety of activities	D9–3 select and apply rules, routines and procedures for safety in a variety of activities from all movement dimensions
D7–4 explain the benefits of, and demonstrate safe, warm-up and cool-down activities	D8–4 design and perform warm-up and cool-down activities	D9–4 analyze, design and perform warm-up and cool-down activities
D7–5 recommend safe movement experiences that promote an active, healthy lifestyle; e.g., protective equipment for in-line skating, ball hockey	D8–5 appraise or judge movement experiences for safety that promote an active, healthy lifestyle; e.g., safe use of equipment	D9–5 design safe movement experiences that promote an active, healthy lifestyle; e.g., student-created games

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GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Physical Education 10 [D10–]	Physical Education 20 [D20–]	Physical Education 30 D30–]
Students will:		
Effort		
D10–1 demonstrate a commitment to an active lifestyle through participation in and out of class	D20–1 model an active lifestyle	D30–1 model an active lifestyle
D10–2 develop a personal plan that is self-motivating and encourages ongoing participation	D20–2 refine a personal plan that is self-motivating and encourages ongoing participation	D30–2 recommend future changes and modifications to one's personal plan to maintain a healthy, active lifestyle
Safety		
D10–3 select and apply rules, routines and procedures of safety in a variety of activities	D20–3 develop and apply safety standards and rules in a variety of activities	D30–3 develop and apply safety standards and rules in a variety of activities
D10–4 analyze, design and assess warm-up and cool-down activities	D20–4 analyze, design and assess warm-up and cool-down activities	D30–4 analyze, design and assess warm-up and cool-down activities
D10–5 define and understand first aid principles and survival skills, including cardiopulmonary resuscitation (CPR), as they relate to physical activity; e.g., aquatics; and, demonstrate responsibility for actions taken to address immediate and potential hazards that might affect self and others	D20–5 demonstrate first aid principles and survival skills as they relate to physical activity; e.g., camping; and, identify and analyze potential hazards that might affect self and others	D30–5 apply the use of first aid principles and survival skills as they relate to physical activity; e.g., athletic training; and, recommend actions that will minimize potential hazards to self and others

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Do it Daily ... for Life!

GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Kindergarten [DK–]	Grade 1 [D1–]	Grade 2 [D2–]	Grade 3 [D3–]

Students will:

Goal Setting/Personal Challenge

DK–6	participate in a class activity with a group goal; e.g., walk a predetermined distance	D1–6	participate in a class activity with a group goal; e.g., walk a predetermined distance	D2–6	practise setting a short-term goal related to positive effort to participate in a physical activity	D3–6	set and achieve a short-term goal to increase effort and participation in one area of physical activity
DK–7	make choices to be involved in a variety of movement experiences	D1–7	try a challenging movement experience based on personal abilities	D2–7	identify ways to change an activity to make it a challenge based on personal abilities	D3–7	identify ways to change an activity to make it a challenge based on personal abilities

Active Living in the Community

DK–8	describe appropriate places for children to play	D1–8	identify and experience safe places to play in the community	D2–8	identify types of physical activities people choose within the community	D3–8	describe types of physical activities people choose within the community and reasons for their choices
DK–9	make choices to be active	D1–9	make decisions to be active	D2–9	make appropriate movement choices considering personal space, safety, ability and the surrounding environment	D3–9	make appropriate movement choices with consideration for safety of personal space, ability and surrounding environment

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GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Grade 4 [D4–1]	Grade 5 [D5–]	Grade 6 [D6–]
Students will:		
Goal Setting/Personal Challenge		
D4–6 set and achieve a long-term goal to increase effort and participation in one area of physical activity	D5–6 set long-term goals to improve personal performance based on interests and abilities	D6–6 set and modify goals to improve personal performance based on interests and abilities
D4–7 demonstrate different ways to achieve an activity goal that is personally challenging	D5–7 demonstrate different ways to achieve an activity goal that is personally challenging	D6–7 analyze and create different ways to achieve an activity goal that is personally challenging
Active Living in the Community		
D4–8 identify how people, facilities and communities influence physical activity	D5–8 create a strategy to promote participation in physical activity within the school and the community	D6–8 examine factors that influence community decisions to support and promote physical activity
D4–9 make decisions to be active within group activities or individually	D5–9 identify factors made to be active within group or individual activities on a daily basis	D6–9 choose and actively participate in a new group or individual activity that encourages daily participation

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GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Grade 7 [D7–]	Grade 8 [D8–]	Grade 9 [D9–]
Students will:		
Goal Setting/Personal Challenge		
D7–6 record and analyze personal goals based on interests and abilities	D8–6 monitor, revise and refine personal goals based on interests and abilities	D9–6 determine and articulate challenging personal and team goals based on interests and abilities
D7–7 evaluate different ways to achieve an activity goal, and determine a personal approach that is challenging	D8–7 evaluate different ways to achieve an activity goal, and determine personal and team approaches that are challenging for both the individual and the group	D9–7 evaluate different ways to achieve an activity goal, and determine personal and team approaches that are challenging for both the individual and the group
Active Living in the Community		
D7–8 identify local community programs that promote physically active lifestyles	D8–8 analyze community programs that promote a physically active lifestyle	D9–8 evaluate community programs that promote physically active lifestyles and how they meet local needs
D7–9 identify factors that affect choices of daily physical activity for life, and create personal strategies to overcome barriers	D8–9 analyze factors that affect choices of physical activity for life, and create personal strategies to overcome barriers	D9–9 develop strategies to counteract influences that limit involvement in physical activity

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Do it Daily ... for Life!

GENERAL OUTCOME D

Students will assume responsibility to lead an active way of life.

Physical Education 10	Physical Education 20	Physical Education 30
Students will:		
Goal Setting/Personal Challenge		
D10–6 analyze current physical activity lifestyles and establish personally challenging goals to maintain participation for life	D20–6 determine short- and long-term activity goals and a timeline for their attainment that will continue to provide personal challenges	D30–6 evaluate and revise short- and long-term activity goals that will continue to provide personal challenges
D10–7 N/A	D20–7 N/A	D30–7 N/A
Active Living in the Community		
D10–8 investigate participation in community activity programs for all ages and the influences that affect participation	D20–8 perform service, leadership and volunteer work related to physical activity, in the school and/or community	D30–8 perform service, leadership and volunteer work related to physical activity, in the school and/or community
D10–9 demonstrate decision-making skills that reflect choices for daily activity within the school and the community	D20–9 evaluate the issues that affect decision making in relation to being active daily	D30–9 develop strategies to offset influences that limit involvement in physical activity

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SCIENCE

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Science
(Vision Statement, 1994)

★ Science 10

Biology 20–30

Chemistry 20–30

Physics 20–30

★ Science 20–30

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★ Copies of the interim Science 10 and Science 20–30 programs of study, dated June 30, 1995, are available for purchase from the Learning Resources Distributing Centre.

Internet

The Science Vision Statement, and all the science programs of study, are available for viewing and downloading at <http://ednet.edc.gov.ab.ca> under Students and Learning, Student Programs, Science.

SCIENCE

VISION STATEMENT: SENIOR HIGH SCIENCE PROGRAMS

The senior high science programs will help all students attain the scientific awareness needed to function as effective members of society. Students will be able to pursue further studies and careers in science, and come to a better understanding of themselves and the world around them. The same framework was used for the development of all the senior high science programs, including Science 10, Biology 20–30, Chemistry 20–30, Physics 20–30 and Science 20–30. The expected student knowledge, skills and attitudes are approached from a common philosophical position in each science course.

In the senior high science programs, students focus on learning the big interconnecting ideas and principles. These ideas, or major themes, originate from science knowledge that transcends and unifies the natural science disciplines. These themes include change, diversity, energy, equilibrium, matter and systems; the process by which scientific knowledge is developed, including the role of experimental evidence; and the connections among science, technology and society. In addition to forming a framework for the curriculum, these ideas provide continuity with the junior high program and build on students' previous learning.

The senior high science programs place an increased emphasis on developing methods of inquiry that characterize the study of science. For example, students will further their ability to ask questions, investigate and experiment; gather, analyze and assess scientific information; and test scientific principles and their applications. They will develop their problem-solving ability and use technology. By providing students with opportunities to develop and apply these skills, they will better understand the knowledge they have acquired.

Students will be expected to show an appreciation for the roles of science and technology in understanding nature. They will possess enthusiasm and positive attitudes toward science and maintain a lifelong interest in science.

The learning context is an integral part of the senior high science programs. It will foster the expected attitudes in students, further the development of students' skills and increase students' understanding of science knowledge, science process, and the connections among science, technology and society. The context for learning will be relevant so students will experience science as interesting and dynamic. Learning opportunities will be made meaningful by providing concrete experiences that students can relate to their world.

The senior high science programs place students at the centre. Students are active learners and will assume increased responsibility for their learning. They will appreciate the value of teamwork and make a positive contribution when working with others to solve problems and complete tasks.

SCIENCE 10

A. COURSE RATIONALE AND PHILOSOPHY

Science by its very nature is interesting, exciting and dynamic. Through the study of science, students are given the opportunity to explore and understand the natural world and to become aware of the importance of science to their lives. Meaningful learning takes place when the study of science relates to what learners already know, deem personally useful and consider relevant. Young people learn best from concrete experiences that present an authentic view of science. In Science 10, students learn science in relevant contexts and engage in meaningful activities. This facilitates the transfer of knowledge to new contexts. Students are encouraged to participate in lifelong scientific learning and to appreciate science as a remarkable, inspiring and stimulating human enterprise with practical impact on their lives and on society as a whole.

Science is experimental, creative and imaginative; methods of inquiry characterize the study of science. In Science 10, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop critical thinking skills. Through experimentation, problem-solving activities and independent study, students develop an understanding of the processes by which scientific knowledge evolves.

Science 10 places students at the centre. Students are active learners and will assume increased responsibility for their learning as they work through the course. A thorough study of science is required to give students an understanding of science that encourages them to make appropriate applications of scientific concepts to their daily lives. Students are expected to participate actively in their own learning; teachers act as collaborators or guides. An emphasis on the key concepts and principles of science provides students with a more unified view of the natural sciences and a greater awareness of the connections among them.

GOALS

The major goals of Science 10 are:

- to develop in students an understanding of the big interconnecting ideas and principles that transcend and unify the natural science disciplines
- to provide students with an enhanced understanding of the scientific world view, inquiry and enterprise
- to help students attain the level of scientific awareness that is essential for all citizens in a scientifically literate society
- to help students make informed decisions about further studies and careers in science
- to provide students with opportunities for acquiring knowledge, skills and attitudes that contribute to personal development.

Science 10 is an integrated academic course that helps students better understand and apply the fundamental concepts and skills that are common to biology, chemistry, physics and earth science. Science 10 is a prerequisite for the 20-level science courses. Primarily, the focus is qualitative to help students understand the scientific principles behind the natural events they experience and the technology they use in their daily lives. It encourages enthusiasm for the scientific enterprise and develops positive attitudes about science as an interesting human activity with personal meaning. It develops in students the knowledge, skills and attitudes to help them become capable of, and committed to, setting goals, making informed choices and acting in ways that will improve their own lives and life in their communities.

B. GENERAL LEARNER EXPECTATIONS

The general learner expectations outline the many facets of scientific awareness and serve as the foundation for specific learner expectations. The general learner expectations are developed through the study of individual units in Science 10, where attitudes, skills and knowledge develop concurrently.

ATTITUDES

Students will be encouraged to develop:

- an enthusiasm for, and a continuing interest in, science
- the effective attributes of scientists at work; such as, respect for evidence, tolerance of uncertainty, intellectual honesty, creativity, perseverance, cooperation, curiosity and a desire to understand
- positive attitudes toward scientific skills involving mathematics, problem-solving and process skills
- open-mindedness and respect for others' points of view
- a sensitivity to the living and non-living environment
- an appreciation for the roles of science and technology in our understanding of the natural world.

SKILLS

Students will be expected to develop an ability to use thinking processes associated with the practice of science for understanding and exploring natural phenomena, problem solving and decision making. These processes involve many skills that are to be developed within the context of the program content.

The skills framework presented here assumes that thinking processes often begin with an unresolved problem or issue or an unanswered question. The problem, issue or question is usually defined and hypotheses formulated before information gathering can begin. At certain points in the process, the information needs to be organized and analyzed. Additional ideas may be generated—for example, by prediction or inference—and those new ideas, when incorporated with previous learning, can create a new knowledge structure. Eventually, an outcome such as a solution, an answer or a decision is reached. Finally, criteria are established to judge ideas and information in order to assess both the problem-solving process and its outcomes.

The following skills are not intended to be developed sequentially or separately. Effective thinking appears to be non-linear and recursive. Students should be able to access skills and strategies flexibly; select and use a skill, process or technology that is appropriate to the task; and monitor, modify or replace it with a more effective strategy.

- Initiating and Planning
  - identify and clearly state the problem or issue to be investigated
  - differentiate between relevant and irrelevant data or information
  - assemble and record background information
  - identify all variables and controls
  - identify materials and apparatus required
  - formulate questions, hypotheses and/or predictions to guide research
  - design and/or describe a plan for research or to solve the problem
  - prepare required observation charts or diagrams
- Collecting and Recording
  - carry out and modify the procedure, if necessary
  - organize and correctly use apparatus and materials to collect reliable experimental data

- accurately observe, gather and record data or information according to safety regulations (e.g., WHMIS) and environmental considerations

- Organizing and Communicating

  - organize and present data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
  - communicate data more effectively, using mathematical and statistical calculations where necessary
  - express measured and calculated quantities to the appropriate number of significant digits, and use appropriate SI units for all quantities
  - communicate findings of investigations in a clearly written report

- Analyzing

  - analyze data or information for trends, patterns, relationships, reliability and accuracy
  - identify and discuss sources of error and their effect on results
  - identify assumptions, attributes, biases, claims or reasons
  - identify main ideas

- Connecting, Synthesizing and Integrating

  - predict from data or information
  - formulate further testable hypotheses supported by the knowledge and understanding generated
  - identify further problems or issues to be investigated
  - identify alternatives for consideration
  - propose and explain interpretations or conclusions
  - develop theoretical explanations
  - relate the data or information to laws, principles, models or theories identified in background information
  - answer the problem investigated
  - summarize and communicate findings
  - decide on a course of action

- Evaluating the Process or Outcomes

  - establish criteria to judge data or information
  - consider consequences and perspectives
  - identify limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design processes or methods used
  - suggest alternatives and consider improvements to experimental technique and design
  - evaluate and assess ideas, information and alternatives

Further Reading

For a more detailed discussion on how to integrate thinking and research skills into the science classroom, refer to the Alberta Education publications: *Teaching Thinking: Enhancing Learning* (1990) and *Focus on Research* (1990).

KNOWLEDGE

Science Themes

Students will be expected to demonstrate an understanding of themes that transcend the discipline boundaries and show the unity among the natural sciences, including:

- Change: how all natural entities are modified over time, how the direction of change might be predicted and, in some instances, how change can be controlled

- Diversity: the array of living and non-living forms of matter and the procedures used to understand, classify and distinguish those forms on the basis of recurring patterns

- Energy: the capacity for doing work, which drives much of what takes place in the universe through its variety of interconvertible forms

- Equilibrium: the state in which opposing forces or processes balance in a static or dynamic way
- Matter: the constituent parts and the variety of states of the material in the physical world
- Systems: the interrelated groups of things or events that can be defined by their boundaries and, in some instances, by their inputs and outputs.

Science, Technology and Society (STS)

Students will be expected to demonstrate an understanding of the processes by which scientific knowledge is developed, and of the interrelationship of science, technology and society, including:

- the central role of experimental evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

Further Reading

For further reading on integrating science, technology and society into the classroom, refer to the Alberta Education publication: *STS Science Education: Unifying the Goals of Science Education* (1990).

C. SPECIFIC LEARNER EXPECTATIONS

LEARNING CYCLE

The specific learner expectations consist of the attitudes, skills and knowledge that are to be addressed in Science 10. The use of the learning cycle allows students to progress from:

- an introduction that frames a lesson in an STS connection that is relevant to the lives of the learners, to
- the experiential exploration of a new idea or content, through
- a hypothesis-building stage where concepts are developed to describe the results of the initial exploration, to
- an application phase where the hypotheses, vocabulary and patterns previously developed are applied to new situations and related to key concepts and principles of science, to
- a final evaluation of the significance of the new learning in an STS context.

Students examine phenomena in a variety of areas to show the relationships among the traditional science disciplines. Wherever possible, examples are drawn from their own experience to enable students to make the connection between scientific knowledge and the society around them, the technology that societies have developed, and the nature of science itself.

COURSE OVERVIEW

Science 10 emphasizes three of the key concepts of science: *energy, matter* and *change.* The concepts of *systems, diversity* and *equilibrium* are included as well but receive less emphasis. These conceptual themes provide a means of showing the connections among the scientific disciplines, and provide a framework for teachers to show students how individual sections of the course relate to the big ideas of science.

In addition to developing a solid understanding of the fundamental science concepts and principles, Science 10 has the goal of educating students about the nature of science and the interaction of science and technology. Students are made aware of the tremendous impact of science and technology on society, as well as the roles and limitations of science and technology in STS problem solving.

Science 10 consists of four units of study:

Unit 1: Energy from the Sun
Unit 2: Matter and Energy in Living Systems
Unit 3: Matter and Energy in Chemical Change
Unit 4: Energy and Change.

Unit 1 focuses on the role of radiant energy from the Sun in sustaining life and driving weather systems on Earth. In Unit 2, the processes by which matter and energy are exchanged between living systems and their environment are studied, and change is illustrated by the growth of living organisms. Unit 3 investigates the changes in matter and energy that occur during chemical reactions. Unit 4 examines different forms of energy and the principles that govern energy transformations.

UNIT 1
ENERGY FROM THE SUN

OVERVIEW

Science Themes: *Energy, Matter* and *Change*

In Unit 1, students investigate how radiant *energy* from the Sun sustains life and drives weather systems on Earth. The properties of water are studied and compared with the properties of other forms of *matter*. Students investigate the role of water in moderating the *changes* in the Sun's *energy* as it moves through the biosphere.

This unit builds on Science 8, Unit 5: Growing Plants; and Science 9, Unit 3: Heat Energy: Transfer and Conservation, and provides students with a foundation for the study of ecosystems and alternative *energy* sources in the 20- and 30-level science courses.

The three **major concepts** developed in this unit are:

- *energy* from the Sun sustains life on Earth
- the properties of water, relative to other forms of *matter*, profoundly influence the nature of life on Earth
- weather *systems* moving through the hydrosphere and the atmosphere are driven by *energy* from the Sun.

In this unit, students will develop an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- collecting and recording
- organizing and communicating
- analyzing data from their investigations of the Sun's *energy* and the properties of water.

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology.

ATTITUDES

Students will be encouraged to:

- develop a questioning attitude concerning natural phenomena
- appreciate the importance of solar energy in sustaining life and driving weather systems on Earth
- appreciate the importance of water in determining the nature of life on Earth
- recognize that scientific knowledge of meteorological phenomena is cumulative and subject to change
- respect the role of empirical evidence in developing scientific theories related to weather
- recognize the limits of current scientific theories in predicting natural phenomena, such as weather.

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

1. Energy from the Sun sustains life on Earth.	• energy from the Sun sustains life on Earth, by extending from Science 8, Unit 5, the life processes of plants, and by:
	  • defining photosynthesis as the process by which green plants put together carbon dioxide and water to store energy and form carbohydrates and oxygen
	  • defining aerobic respiration as the process by which organisms release energy by reacting on carbohydrates and oxygen to form carbon dioxide and water
	  • indicating that all life on Earth exists in the biosphere, a relatively thin spherical shell having an approximate thickness of 15 kilometres
	  • indicating that the biosphere exists within the three major spherical layers of Earth—the atmosphere, the hydrosphere and the lithosphere

2. The properties of water, relative to other forms of matter, profoundly influence the nature of life on Earth.	• the properties of water, including surface tension, melting point, boiling point, specific heat capacity, heat of fusion, heat of vaporization, expansion on freezing, and maximum density at 4°C, profoundly influence the nature of life on Earth, by:
	  • extending from Science 9, Unit 3, that heat is a form of energy and may be quantified using $Q = mc\Delta T$
	  • calculating the thermal energy involved when a measured mass of water undergoes a measured temperature change
	  • relating the hydrologic cycle to solar energy
	  • relating the properties of water to the maintenance of constant body temperature
	  • indicating why ice forms on the surface of water, and relating this to the winter survival of aquatic organisms

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• performing an experiment to investigate the production of carbohydrates and oxygen by green plants • identifying the manipulated, responding and controlled variables (variables held constant) in an experimental investigation of photosynthesis • designing a closed system to illustrate the dynamic balance between photosynthesis and respiration • tracing the flow of energy through the biosphere, using diagrams	• tracing the energy contained in a typical student lunch to its source in the Sun • describing how a greenhouse can be used as a model of Earth's atmosphere • describing the technology used to monitor levels of atmospheric gases • discussing the implications of global deforestation
• observing and recording some of the physical properties of water • collecting and graphing data showing the effect of heat on the temperature of water • performing an experiment to determine the heat of fusion of ice • graphing and analyzing data showing how the density of water varies with temperature • designing an experiment to investigate the change in volume of water on freezing	• explaining why perspiration can keep a person from overheating on a hot day • describing how the expansion of water, upon freezing, is accounted for in construction in cold climates • explaining technologies that use solar energy to desalinate water, in terms of the scientific principles involved • describing technologies that use water to maintain a uniform temperature in buildings in terms of the scientific principles involved

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

3. Weather systems moving through the hydrosphere and the atmosphere are driven by energy from the Sun.	• weather systems moving through the hydrosphere and the atmosphere are driven by energy from the Sun, by:
	  • explaining why large bodies of water have a moderating effect on the climate of surrounding areas
	  • describing the role of ocean currents in transferring thermal energy; e.g., Gulf Stream, Japan Current, El Nino
	  • relating latitude and surface characteristics (e.g., snow, oceans, forests) to the amount of solar energy absorbed and lost by Earth
	  • explaining the significance of the differential solar heating of equatorial and polar regions in the transfer of thermal energy
	  • explaining weather changes in terms of pressure systems, cold and warm fronts, and the Coriolis effect
	  • explaining the occurrence of chinooks in terms of the heat produced by the compression of air
	  • explaining the formation of thunderstorms and hailstorms in terms of vertical air currents
	  • explaining the formation of tornadoes in terms of vertical air currents and a cold front.

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• comparing mean monthly temperature data for cities of similar latitude and accounting for any differences	• explaining the difference in climate between the Prairies and the West Coast
• constructing and interpreting climate graphs	• explaining how local weather phenomena are driven by energy from the Sun
• designing an experiment to investigate the heating effect of solar energy	• describing the operation of weather satellites in monitoring weather systems
• observing and describing the Coriolis effect	• describing the operation of radar in tracking thunderstorms
• evaluating meteorological models currently used to explain and predict weather patterns	• explaining how more accurate weather predictions could benefit millions of people globally.
• performing an experiment to investigate the heat changes involved in the compression and expansion of air	
• communicating meteorological data in SI units; e.g., temperature, wind velocity, atmospheric pressure, precipitation.	

UNIT 2
MATTER AND ENERGY IN LIVING SYSTEMS

OVERVIEW

Science Themes: *Energy, Matter* and *Change*

In Unit 2, students investigate how *matter* and *energy* are exchanged between living systems and their environment, and examine the *changes* involved in the growth of living organisms. The energetics of diffusion, osmosis and active transport are analyzed. The limitations that diffusion places on growth, and the significance of transport in multicellular organisms are examined.

This unit builds upon Science 8, Unit 5: Growing Plants, and Unit 6: Interactions and Environments, and continues from Science 10, Unit 1: Energy from the Sun, the study of photosynthesis and respiration. The attitudes, knowledge and skills developed in this unit provide students with a sound background for the further study of living systems in Science 20 and Biology 20.

The four **major concepts** developed in this unit are:

- the cell is the basic unit of living *systems*
- growth is a major feature of living *systems*, and a major limitation to growth is the surface to volume ratio of the cell
- the cell is an open *system* exchanging *matter* and *energy* with the environment
- multicellular organisms provide for the *matter* and *energy* needs of cells at a distance from the organisms' interface with the environment.

In this unit, students will develop an ability to use the **skills and thinking processes** associated with the practice of science, emphasizing:

- collecting and recording
- organizing and communicating
- analyzing data from their investigations of living *systems*.

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems.

ATTITUDES

Students will be encouraged to:

- appreciate the unity of science through the application of physical and chemical principles to biological systems
- appreciate that biological principles emerge from the investigation of the structure and function of living systems
- appreciate that many fundamental biological processes operate at both the cellular and higher levels of organization
- appreciate that the maintenance of homeostasis relies on equilibria within the organism and between the organism and its environment
- develop a curiosity to obtain a deeper understanding of biological systems
- appreciate that our knowledge of biology has been enhanced by the application of technology
- appreciate that the application of technology can have beneficial and harmful effects on biological systems.

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

1. The cell is the basic unit of living systems.	• the cell is the basic unit of living systems, by:
	  • describing the structure of the cell membrane, nucleus, nucleoid, endoplasmic reticulum, Golgi apparatus, lysosome, vacuole, mitochondrion, chloroplast, ribosome, cytoskeleton and cell wall, where present, in bacteria, plant and animal cells
	  • identifying the functions of the cell membrane and organelles
	  • describing the similarities and differences in the structure and function of prokaryotic and eukaryotic cells

2. Growth is a major feature of living systems, and a major limitation to growth is the surface to volume ratio of the cell.	• growth is a major feature of living systems, and a major limitation to growth is the surface to volume ratio of the cell, by:
	  • describing what is meant by growth in terms of both an increase in the number of cells by fission or mitosis, and the increase in size or weight of a cell or organism
	  • describing how the surface to volume ratio of a cell might limit its growth, and inferring the value of multicellularity in enhancing the ability to use nutrients
	  • explaining how division of labour occurs within a single cell and, after the process of differentiation, in a multicellular organism

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• identifying cellular structures in living and prepared materials by using dissecting and compound microscopes and by examining electron micrographs	• drawing analogies between the division of labour within cells and that of the differentiation of the functional systems of the human body or of a community
• preparing plant and animal material for microscopic examination, using stains and observing the materials	• describing how developments in the technology of microscopes have led to an increase in our knowledge and understanding of cell structure
• estimating the size of cellular structures identified from a knowledge of microscope magnification power	• researching the development of the electron microscope, a Canadian invention
• observing and recording changes in growing plant cells	• describing examples of the use of bacteria in research and industrial processes
• calculating and graphing the surface to volume ratios of a variety of model cell sizes and shapes	• identifying and explaining how technological and natural systems demonstrate that surface area maximization facilitates the transfer of heat, gases, nutrients or wastes; e.g., car radiators, fish gills, intestinal villi, elephant ears, dialysis machines, aquarium pumps, heart–lung machines, alveoli, nasal membranes, capillary networks, roots and leaves
• comparing the surface to volume ratio of various organisms and relating the findings to the organisms' metabolic rate; e.g., hummingbird or shrew compared with elephant or whale	

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

3. The cell is an open system exchanging matter and energy with the environment.	• the cell is an open system exchanging matter and energy with the environment, by extending from Science 8, Unit 5, the life processes of plants, and by:
	  • describing how materials diffuse across a cell membrane in terms of concentration gradients
	  • describing how the semipermeable nature of the cell membrane allows the process of osmosis
	  • describing how metabolic energy may be used to do the work of transporting substances across membranes against their concentration gradients
	  • describing, in general terms, how the energy for active transport is derived from photosynthesis and respiration in the form of adenosine triphosphate (ATP)
	  • describing, in general terms, how the energy in light is stored in plant chloroplasts and then transferred for storage in ATP molecules
	  • describing, in general terms, how carbon dioxide molecules in solution, or in the air, are fixed as carbohydrates in the plant chloroplasts, using the stored light energy

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• investigating the different action of a sucrose solution and a starch solution when placed in separate dialysis bags and immersed in water, and inferring why the solutions behave differently	• explaining how a dialysis machine or the process of peritoneal dialysis can be used to treat people with kidney dysfunction
• performing an experiment to demonstrate the phenomena of plasmolysis and deplasmolysis in plant cells; e.g., staminal hairs or aquatic leaf cells, and describing the observed events in terms of the tonicity of the cells and solutions	• explaining how eating solid food can provide one with nutrition
• inferring how biochemical interconversion of starch and glucose might regulate the turgor pressure of cells	• explaining how a knowledge of diffusion and osmosis can be used in industrial applications; e.g., the desalination of sea water
• observing and diagramming the locomotion of *Amoeba* and inferring how this movement relates to the process of endocytosis and exocytosis	• describing how the ability to compress gases has enabled humans to climb high mountains and work in deep oceans
• observing and/or researching the nutrient acquisition of selected protists, plants and animals, and describing such processes with clearly labelled diagrams	• explaining what occurs when a person suffers from altitude sickness or caisson disease
	• summarizing articles from periodicals regarding the latest scientific and/or technological developments; e.g., kidney research
	• explaining how oral rehydration therapy is used to treat cholera

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
4. Multicellular organisms provide for the matter and energy needs of cells at a distance from the organisms' interface with the environment.	• multicellular organisms provide for the matter and energy needs of cells at a distance from the organisms' interface with the environment, by extending from Science 9, Unit 1, that living things show a diversity of structural adaptation, and by: • comparing and contrasting how the selected organisms transport nutrients and wastes over short and long distances, and discussing the differences in terms of the biology of the organisms • comparing and contrasting how selected organisms acquire nutrients and remove wastes, and discussing the differences in terms of the biology of the organisms • comparing and contrasting how selected organisms exchange gases, and discussing the differences in terms of the biology of the organisms.

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• observing and describing the appearance of cytoplasmic streaming in *Amoeba* or a plant cell, and inferring similar movement in most cells of a multicellular organism • identifying diverse pairs or organisms and comparing them with respect to transport systems; e.g., *Amoeba* and giraffe, a single-celled alga and a redwood tree • observing and recording the movement of water in plants.	• drawing appropriate analogies for nutrient distribution in multicellular organisms; e.g., animal versus factory • researching and explaining how the vacuum tapping system, invented by a Canadian, takes advantage of the natural transport system of maple trees • describing how a systemic pesticide is taken up and distributed throughout a plant; e.g., the fungicide used to treat Dutch elm disease • discussing the positive and negative features of commonly used systemic pesticides.

UNIT 3
MATTER AND ENERGY IN CHEMICAL CHANGE

OVERVIEW

Science Themes: *Energy*, *Matter* and *Change*

In Unit 3, students investigate how *matter* and *energy* are involved in chemical change. Students study the patterns among the properties of the elements that form the basis of the periodic table. A simple model of the atom is presented to explain the chemical properties of *matter* and the *energy* effects of chemical *change*. To deal with the vast array of compounds created by combining elements, a system of chemical nomenclature is introduced.

This unit builds on Science 8, Unit 1: Solutions and Substances; and Science 9, Unit 5: Chemical Properties and Changes, and provides students with a foundation for the further study of chemical change in Science 20 and Chemistry 20.

The five **major concepts** developed in this unit are:

- *matter* is classified on the basis of its properties
- *matter* has a well defined underlying structure
- elements combine to form a vast array of compounds
- *energy* is involved in each *change* that *matter* undergoes
- *matter* is conserved in chemical *changes*.

In this unit, students will develop an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- collecting and recording
- organizing and communicating
- analyzing data from their investigations of chemical *change*.

The **STS connections** in this unit illustrate:

- the ways in which science advances technology and technology advances science
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate the orderliness of nature and the characteristic pattern in the properties of matter
- appreciate that careful and precise observations form the basis for generalizations about the nature of matter
- tolerate the uncertainty in our explanations of the nature of matter
- value the contribution of science and technology to our understanding of the nature of matter
- value the need for safe handling and disposal of chemicals
- demonstrate an awareness of the impact that humans have had on the environment through the manipulation of matter for personal and industrial use
- appreciate the benefits that have resulted from applications based on chemical principles.

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Matter is classified on the basis of its properties.	• matter is classified on the basis of its properties, by extending from Science 8, Unit 1, and Science 9, Unit 5, the major categories of matter (e.g., pure substance, mixture, element, compound, solution) and the differences between physical and chemical properties, and by: • explaining that matter is everything that has mass and occupies space • explaining the classification of elements in the periodic table in terms of chemical properties • predicting the properties of elements from their position on the periodic table, and the placement of elements on the periodic table from their properties • identifying the elements that are most prevalent in living systems
2. Matter has a well defined underlying structure.	• matter consists of atoms, ions and molecules, by: • providing definitions for the following chemical species: atoms (isotope, radioisotope), ions, molecules • indicating the relative sizes of chemical species compared to microscopic and macroscopic species • describing the extent to which we are able to observe chemical species with modern technology

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• handling reactive materials safely	• describing how WHMIS symbols are used to classify potentially hazardous materials
• using common separation techniques, such as filtration, extraction, distillation and chromatography	• describing some of the physiological effects of heavy metals, such as lead and mercury, and the possible sources of contamination in everyday life
• using observation and experimentation to study the properties of matter, and to classify various examples of matter	• explaining why most metals must be separated from their ores and protected to prevent corrosion
• observing chemical and physical properties of representative elements, noting the patterns	
• building models of the structure of the atom, including protons, neutrons and electrons—their relative size, charge, mass and position	• illustrating, with examples, how radioactive substances are used in medical research and treatment
	• discussing the merits of spending public money on investigating atomic structure

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

3. Elements combine to form a vast array of compounds.	• elements combine to form compounds that have characteristic properties and are assigned individual names, by:
	  • differentiating, on the basis of properties (conductivity, pH, etc.), among ionic and molecular compounds, including acids and bases
	  • identifying the role of several compounds in living systems
	  • naming and writing formulas for selected ionic and molecular compounds, including acids and bases

4. Energy is involved in each change that matter undergoes.	• energy is involved in each change that matter undergoes, by:
	  • comparing and contrasting physical, chemical and nuclear changes
	  • differentiating between endothermic and exothermic changes
	  • identifying types of chemical reactions; e.g., formation, decomposition, combustion, replacement
	  • writing word equations for chemical reactions that occur in living and non-living systems

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• investigating the properties of representative ionic and molecular compounds, including acids and bases, in laboratory experiments and in resources, such as a chemistry handbook • using equipment, such as Bunsen burners and laboratory glassware, correctly and safely • handling and disposing of chemicals in a safe, responsible manner	• listing several common compounds that are essential to human health • listing several common compounds that are hazardous to human health and the environment • discussing the disposal problem related to used materials • outlining safe methods for handling hazardous substances in the home
• performing experiments that illustrate chemical changes	• providing examples of processes that use physical and/or chemical changes to produce useful substances and energy • identifying chemical reactions that are harmful to the environment; e.g., destruction of the ozone layer by chlorofluorocarbons, formation of acid rain and greenhouse gases

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

5. Matter is conserved in chemical changes.	• the conservation of mass in chemical changes can be illustrated and quantified, by:
	  • outlining experiments, such as van Helmont's and Lavoisier's, investigating mass changes in chemical reactions
	  • writing chemical equations that include the state of matter for each substance, and balancing the equations in terms of chemical species and moles.

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• performing an experiment that demonstrates the principles behind Lavoisier's experiments on combustion, which led to the conclusion that burning substances gain mass by combining with oxygen from the air	• explaining the use of balances in analytical chemistry
• illustrating, through measurements and calculations involving moles and molar masses, that matter is conserved in chemical changes.	• using a calculator for calculations involving moles.

UNIT 4
ENERGY AND CHANGE

OVERVIEW

Science Themes: *Energy, Matter* and *Change*

In Unit 4, students quantitatively investigate *energy* changes and develop their understanding of *energy* transformation and conservation. The unit concludes with a project in which students design and build a simple *energy* conversion device and evaluate its efficiency.

This unit builds on Science 7, Unit 3: Force and Motion, and Unit 4: Temperature and Heat Measurement; Science 9, Unit 3: Heat Energy: Transfer and Conservation, and extends the concepts of *energy* transformation introduced in Unit 1, and treated in their biological and chemical contexts in Units 2 and 3. The attitudes, knowledge and skills developed in this unit provide students with a foundation for the study of energy and conservation topics in Science 20 and Physics 20.

The four **major concepts** developed in this unit are:

- *energy* is always associated with *change*
- *energy* can be transformed from one form to another
- *energy* cannot be created or destroyed, only converted from one form into another
- the useful *energy* diminishes during any *energy* transformation.

In this unit, students will develop an ability to use the **skills and thinking processes** associated with the practice of science, emphasizing:

- collecting and recording
- organizing and communicating
- analyzing data from their investigations of *energy* change.

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems
- the ability and the responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- develop a positive attitude toward mathematical, communication and scientific processes and skills in the study of energy
- appreciate the need for computational competence in quantifying energy and energy transfers
- respect evidence when interpreting observed phenomena related to energy
- appreciate that science is a disciplined way to develop explanations and descriptions about energy in the natural and technological world
- accept uncertainty in our descriptions and explanations of observations related to energy in the physical world.

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

1. Energy is always associated with change.	• energy is always associated with change, by extending from Science 8, Unit 2, the definition of mechanical work, and quantifying the work done on/by an object, using $W = Fd$; by extending from Science 7, Unit 3, the notions of force, mass and weight; and by:
	  • illustrating, by use of examples, that energy exists in a variety of forms; e.g., mechanical, chemical, electrical, thermal, nuclear and solar
	  • illustrating, by use of examples, that the Sun is the source of most energy forms on Earth
	  • describing one-dimensional uniform motion, using graphical and mathematical techniques
	  • defining energy as the property of a system that is a measure of its capacity for doing work, and work is the transfer of energy
	  • deriving the unit of energy and work, the joule, from fundamental units

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• making a synopsis of energy as it has been discussed in earlier units	• discussing the importance of the Sun as an energy source for life on Earth
• tracing the flow of energy from the Sun to the lighting system in the school, identifying what changes are taking place at each stage of the process	• describing the technologies involved in current sources of energy
• performing an experiment to determine the relationships among distance, speed and time	• analyzing the energy transfers occurring as an automobile or a bicycle comes to a stop
• investigating the relationships among distance, speed and time, using interval timers	• analyzing the movement of passengers in an automobile changing direction
• interpreting the slope of a curve in a distance–time graph in terms of speed	
• interpreting the area under a speed–time graph as the distance travelled	
• interpreting the area under a force–distance graph as the work done	

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

2. Energy can be transformed from one form to another.	• energy can be transformed from one form to another, by extending from Science 7, Unit 4, that thermal energy can be derived from a variety of sources, and by:
	  • defining kinetic energy as energy due to motion, and potential energy as energy due to position or condition
	  • potential energy is only useful when it is transformed to another form of energy
	  • illustrating, by use of examples, that energy transfers produce measurable changes in motion, shape or temperature of matter
	  • defining gravitational potential energy as the work done on a mass against gravity, and quantifying gravitational potential energy, using $E_p = mgh$
	  • quantifying kinetic energy, using $E_k = 1/2mv^2$
	  • recognizing chemical energy as a form of potential energy, and describing the potential energy stored in a battery
	  • quantifying electrical energy, using $E_e = Pt$
	  • explaining the effect of thermal energy on matter, using the kinetic molecular theory as a simple mechanical model
	  • describing temperature changes in terms of changes in the kinetic energy of the molecules of a substance
	  • describing phase changes in terms of the kinetic molecular theory
	  • analyzing units to describe the kilowatt hour as a unit of energy, and the watt as a unit of rate of energy transfer or a unit of doing work

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• investigating energy conversions, using laboratory equipment • calculating the energy consumption of selected household technologies; e.g., toaster, microwave oven or refrigerator • discussing an experiment to demonstrate the conversion of chemical potential energy to thermal energy, involving a combustion reaction • performing an experiment to demonstrate the conversion of energy from a potential form to a kinetic form, using a pendulum • performing an experiment to demonstrate the equivalency of work done on an object, and the resulting kinetic energy	• describing current technologies for converting energy from one form to another; e.g., hydroelectric and coal-burning power stations, solar cells • describing technological devices that use chemical potential energy as an energy source

MAJOR CONCEPTS	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

3. Energy cannot be created or destroyed, only converted from one form into another.	• conservation of energy is a fundamental law of nature, by:
	  • stating the Law of Conservation of Energy as "the sum of initial energies is equal to the sum of final energies"
	  • recognizing the First Law of Thermodynamics as a statement of the Law of Conservation of Energy
	  • describing, by use of examples, that thermal energy will, of its own accord, flow from a hotter body to a cooler body, and recognizing this as a formal statement of the Second Law of Thermodynamics
	  • comparing and contrasting the mechanism of osmosis and thermal energy transfer according to the Second Law of Thermodynamics

4. The useful energy diminishes during any energy transformation.	• the amount of useful energy diminishes during any energy transformation, by:
	  • interpreting empirical data from a study of energy conversions
	  • explaining that energy conversion processes have different efficiencies, based on total energy input compared to the net useful energy output
	  • defining inefficiency as the fraction of energy lost as wasted heat in the conversion process
	  • describing techniques for reducing waste of energy.

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science by:	*Students should be able to demonstrate an understanding of the processes by which scientific knowledge is developed and of the interrelationship of science, technology and society by, among other activities:*
• tracing the stages of energy conversion in a system; e.g., a power plant or food chain, and identifying the sources of energy loss	• describing the energy transfers, and how they are achieved, in various conversion systems; e.g., refrigerator, heat pump, thermal power plant
• designing an experiment to investigate the conservation of energy in a closed system	• commenting on the feasibility of perpetual motion machines
• performing an experiment to demonstrate the similarities between osmosis and thermal energy transfer	• comparing and contrasting the energy transfers and technologies in a hydroelectric plant and a thermal power plant
	• discussing the role of alternative energy sources to generate energy in Alberta
• conducting an investigation in which the efficiency of common technological devices used to heat a specific amount of water is quantified and evaluated	• comparing and contrasting the energy content of fuels used in thermal power plants in Alberta
• performing an experiment in which mechanical energy is converted into heat energy	• discussing the use of fossil fuels in thermal power plants in Alberta
• performing an experiment in which electrical energy is converted into heat energy	• discussing the role of efficiency of energy conversion to encourage responsible energy use
• designing and building an energy conversion device and calculating its efficiency.	• discussing the impact of displaying energy consumption labels on household appliances.

BIOLOGY 20–30

A. PROGRAM OVERVIEW

RATIONALE AND PHILOSOPHY

Biology is the study of life and living systems from the molecular level to the biosphere. Through the study of biology, learners are given an opportunity to explore and understand the natural world and to become aware of the profound influence of biology in their lives. Learning is facilitated by relating the study of biology to what the learners already know, deem personally useful and consider relevant. Learning proceeds best when it originates from a base of concrete experiences presenting an authentic view of science in the context of biology. In Biology 20–30, students learn biology in relevant contexts and engage in meaningful activities. This facilitates the transfer of knowledge to new contexts. Students are encouraged to participate in lifelong learning about biology and to appreciate it as a scientific endeavour with practical impact on their own lives and on society as a whole.

Biology, as with all sciences, is an experimental discipline requiring creativity and imagination. Methods of inquiry characterize its study. In Biology 20–30, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop their critical thinking skills. Through experimentation, and problem-solving activities that include the integration of technology and independent study, students develop an understanding of the processes by which scientific knowledge evolves.

The Biology 20–30 program places students at the centre. Students are active learners and will assume increased responsibility for their learning as they work through the program. A thorough study of biology is required to give students an understanding that encourages them to make appropriate applications of scientific concepts to their daily lives and prepares them for future studies in biology. Students are expected to participate actively in their own learning. An emphasis on the key concepts and principles of biology provides students with a more unified view of the sciences and a greater awareness of the connections among them.

These science learnings will take varying amounts of time to acquire, depending on the individual learning styles and abilities of students. While each course is designed for approximately 125 hours, instructional time can be modified to meet the individual needs of students. Some students will require more than 125 hours, while others will require less.

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GOALS

The major goals of the Biology 20–30 program are:

- to develop in students an understanding of the interconnecting ideas and principles that transcend and unify the natural science disciplines

- to provide students with an enhanced understanding of the scientific world view, inquiry and enterprise

- to help students attain the level of scientific awareness essential for all citizens in a scientifically literate society

- to help students make informed decisions about further studies and careers in science

- to provide students with opportunities for acquiring knowledge, skills and attitudes that contribute to personal development.

Biology 20–30 is an academic program that helps students better understand and apply fundamental concepts and skills. The focus is on helping students understand the biology principles behind the natural events they experience and the technology they use in their daily lives. The program encourages enthusiasm for the scientific enterprise and develops positive attitudes about biology as an interesting human activity with personal meaning. It develops in students the knowledge, skills and attitudes to help them become capable of, and committed to, setting goals, making informed choices and acting in ways that will improve their own lives and life in their communities.

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B. LEARNER EXPECTATIONS

GENERAL LEARNER EXPECTATIONS

The general learner expectations outline the many facets of scientific awareness and serve as the foundation for the specific learner expectations covered in section C. The general learner expectations are developed in two categories: *program* expectations and *course* expectations.

PROGRAM GENERAL LEARNER EXPECTATIONS

The *program* general learner expectations are broad statements of science attitudes, knowledge, skills and science, technology and society (STS) connections that students are expected to achieve in all of the senior high school science programs. These *program* general learner expectations are further refined through the *course* general learner expectations and then developed in specific detail through the study of individual units in each of Biology 20 and Biology 30. All expectations follow a progression from Science 10 through to Biology 30, and though listed separately, are meant to be developed in conjunction with one another, within a context.

ATTITUDES

Students will be encouraged to develop:

- enthusiasm for, and a continuing interest in, science
- affective attributes of scientists at work; such as, respect for evidence, tolerance of uncertainty, intellectual honesty, creativity, perseverance, cooperation, curiosity and a desire to understand
- positive attitudes toward scientific and technological skills involving process skills, mathematics, and problem solving
- open-mindedness and respect for the points of view of others
- sensitivity to the living and nonliving environment
- appreciation of the roles of science and technology in our understanding of the natural world.

KNOWLEDGE

Science Themes

Students will be expected to demonstrate an understanding of themes that transcend the discipline boundaries, and show the unity among the natural sciences, including:

- Change: how all natural entities are modified over time, how the direction of change might be predicted and, in some instances, how change can be controlled
- Diversity: the array of living and nonliving forms of matter and the procedures used to understand, classify and distinguish those forms on the basis of recurring patterns
- Energy: the capacity for doing work that drives much of what takes place in the Universe through its variety of interconvertible forms
- Equilibrium: the state in which opposing forces or processes balance in a static or dynamic way
- Matter: the constituent parts, and the variety of states of the material in the physical world
- Systems: the interrelated groups of things or events that can be defined by their boundaries and, in some instances, by their inputs and outputs.

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SKILLS

Students will be expected to develop an ability to use thinking processes associated with the practice of science for understanding and exploring natural phenomena, problem solving and decision making. Students will also be expected to use teamwork, respect the points of view of others, make reasonable compromises, contribute ideas and effort, and lead when appropriate to achieve the best results. These processes involve many skills that are to be developed within the context of the program content.

Students will also be expected to be aware of the various technologies, including information technology, computer software and interfaces that can be used for collecting, organizing, analyzing and communicating data and information.

The skills framework presented here assumes that thinking processes often begin with an unresolved problem or issue, or an unanswered question. The problem, issue or question is usually defined and hypotheses formulated before information gathering can begin. At certain points in the process, the information needs to be organized and analyzed. Additional ideas may be generated—for example, by prediction or inference—and these new ideas, when incorporated into previous learning, can create a new knowledge structure. Eventually, an outcome, such as a solution, an answer or a decision is reached. Finally, criteria are established to judge ideas and information in order to assess both the problem-solving process and its outcomes.

The following skills are not intended to be developed sequentially or separately. Effective thinking is nonlinear and recursive. Students should be able to access skills and strategies flexibly; select and use skills, processes or technologies that are appropriate to the tasks; and monitor, modify or replace them with more effective strategies.

- Initiating and Planning
  - identify and clearly state the problem or issue to be investigated
  - differentiate between relevant and irrelevant data or information
  - assemble and record background information
  - identify all variables and controls
  - identify materials and apparatus required
  - formulate questions, hypotheses and/or predictions to guide research
  - design and/or describe a plan for research, or to solve a problem
  - prepare required observation charts or diagrams, and carry out preliminary calculations
- Collecting and Recording
  - carry out the procedure and modify, if necessary
  - organize and correctly use apparatus and materials to collect reliable data
  - observe, gather and record data or information accurately according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations
- Organizing and Communicating
  - organize and present data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
  - communicate data effectively, using mathematical and statistical calculations, where necessary
  - express measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
  - communicate findings of investigations in a clearly written report

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- Analyzing
  - analyze data or information for trends, patterns, relationships, reliability and accuracy
  - identify and discuss sources of error and their affect on results
  - identify assumptions, attributes, biases, claims or reasons
  - identify main ideas
- Connecting, Synthesizing and Integrating
  - predict from data or information, and determine whether or not these data verify or falsify the hypothesis and/or prediction
  - formulate further, testable hypotheses supported by the knowledge and understanding generated
  - identify further problems or issues to be investigated
  - identify alternative courses of action, experimental designs, and solutions to problems for consideration
  - propose and explain interpretations or conclusions
  - develop theoretical explanations
  - relate the data or information to laws, principles, models or theories identified in background information
  - propose solutions to a problem being investigated
  - summarize and communicate findings
  - decide on a course of action
- Evaluating the Process or Outcomes
  - establish criteria to judge data or information
  - consider consequences and biases, assumptions and perspectives
  - identify limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used
  - evaluate and suggest alternatives and consider improvements to the experimental technique and design, the decision-making or the problem-solving process
  - evaluate and assess ideas, information and alternatives

CONNECTIONS AMONG SCIENCE, TECHNOLOGY AND SOCIETY

Science, Technology and Society (STS)

Students will be expected to demonstrate an understanding of the processes by which scientific knowledge is developed, and of the interrelationships among science, technology and society, including:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of processes or products based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

FURTHER READING

For a more detailed discussion on how to integrate thinking and research skills into the science classroom, refer to the publications: *Teaching Thinking: Enhancing Learning,* 1990 and *Focus on Research: A Guide to Developing Students' Research Skills,* 1990.

For further reading on integrating science, technology and society into the classroom, refer to the publication: *STS Science Education: Unifying the Goals of Science Education,* 1990.

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COURSE GENERAL LEARNER EXPECTATIONS

The *course* general learner expectations are specific to each of Biology 20 and Biology 30 providing a bridge between the *program* general learner expectations and the specific learner expectations for each unit of study.

The attitudes expectations refer to those predispositions that are to be fostered in students. These expectations encompass attitudes toward science, the role of science and technology, and the contributions of science and technology toward society. The knowledge expectations are the major biology concepts in each course. The skills expectations refer to the thinking processes and abilities associated with the practice of science, including understanding and exploring natural phenomena, and problem solving. The connections among science, technology and society expectations focus on: the processes by which scientific knowledge is developed; the interrelationships among science, technology and society; and links each course to careers, everyday life and subsequent studies of biology.

Although itemized separately, the attitudes, knowledge, skills and STS connections are meant to be developed together within one or more contexts.

Biology 20–30

Attitudes

Students will be encouraged to:

- appreciate the role of empirical evidence and models in science, and accept the uncertainty in explanations and interpretations of observed phenomena
- value the curiosity, openness to new ideas, creativity, perseverance and cooperative hard work required of scientists, and strive to develop these same personal characteristics
- appreciate the role of science and technology in advancing our understanding of the natural world, be open-minded and respectful of other points of view when evaluating scientific information and its applications, and appreciate that the application of science and technology by humankind can have beneficial as well as harmful effects and can cause ethical dilemmas
- show a continuing interest in science, appreciate the need for computational competence, problem-solving and process skills when doing science, and value accuracy and honesty when communicating the results of problems and investigations
- appreciate the complexity of our planet and its diversity of ecosystems, value all organisms and the role they play, appreciate the relationship between humans and their natural environment, and take responsibility toward environmental use within the limits of sustainable development.

Biology 20

Students will be able to:

Knowledge

- explain how equilibrium in the biosphere is maintained by the flow of energy from the Sun through the chemical processes of photosynthesis and cellular respiration, and by the cycling of matter through the biogeochemical cycles; and describe the influence of human activities on the equilibrium of energy and matter exchange and atmospheric composition
- explain the role of structure, function and regulatory mechanisms of the digestive, respiratory, excretory and circulatory systems in energy and matter exchange; and describe blood cellular components, and explain the role of the immune system in protecting the human organism and maintaining internal equilibrium

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- explain how solar energy and matter are converted by cellular photosynthetic processes to ATP or stored in organic compounds as potential chemical energy, and how this potential energy can be converted by cellular respiration to ATP; and describe the influence of oxygen, carbon dioxide and environmental toxins on these processes

- differentiate ecosystems on the basis of the energy and matter exchange of their biotic and abiotic components, by performing field studies on terrestrial and aquatic ecosystems; and explain, quantitatively and qualitatively, the trophic structure of ecosystems, using models, such as food webs, chains and pyramids

- list the direct and indirect evidence that supports the evolution of modern species from ancestral forms; and explain the theory of natural selection and how inherited variability within populations causes evolutionary change and speciation

- explain why populations are the basic components of an ecosystem; and describe the direct and indirect evidence of inherited and acquired variation in population gene pools, and explain the basis for the range of this variation found within individual species of a population

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

- analyze and interpret data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and calculate slopes of, and areas under, straight-line graphs; and derive mathematical relationships among variables

- use mathematical language of ratio and proportion, simple equations, and unit analysis to solve single- and multi-step problems; and to communicate scientific relationships and concepts

Connections Among Science, Technology and Society

- apply cause and effect reasoning to formulate simple relationships for a given instance in which scientific evidence shapes or refutes a theory; and describe the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which biology and technology advance one another, using appropriate and relevant examples

- explain for a given instance how science and technology are influenced and supported by society, and the responsibility of society, through biology and technology, to protect the environment and use natural resources wisely

- identify subject-related careers and apply the knowledge and skills acquired in Biology 20 to everyday life and to related and new concepts in subsequent studies of biology.

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Biology 30

Students will be able to:

Knowledge

- describe the structure and explain the function of nervous and hormonal control systems that enable the human organism to maintain internal equilibrium among its systems while simultaneously interacting and maintaining equilibrium with the external environment; and explain the role of selected hormones in metabolism and homeostasis

- describe mitosis and the cell cycle; and compare mitosis with meiosis and explain the significance to a species of chromosome number reduction and crossing over during meiosis; and describe gametogenesis, fertilization, fetal development and reproductive technologies in humans; and compare and contrast alternation of generations in a range of vascular plants and animals

- describe the anatomy and physiology of single neurons in relation to the initiation, formation and transmission of electrochemical impulses; and explain how sensory receptors, such as the eye and ear, act as energy converters

- describe the anatomy of human reproductive systems; and explain the hormonal control and maintenance of reproductive systems in adults; and describe how sexually transmitted diseases interfere with system function; and describe and explain the physiological events in the fetus that result in the formation of male and female genitalia

- explain heredity; describe direct and indirect evidence for chromosomes, genes, alleles and the influence of crossing over and sex chromosomes, and explain the role of this evidence in formulating the principles of inheritance; and explain the molecular basis of inheritance by describing DNA structure, expression and mutation; and explain the significance of genomes to species and the influence of biotechnology on genes and genomes

- explain the significance of the Hardy–Weinberg equilibrium to gene pools, and the significance of gene pool change over time; and describe the chaos theory and explain and analyze, quantitatively, the factors and strategies that influence population growth

Skills

- perform and evaluate investigations and tasks of their own and others' design that have multiple variables and yield direct or indirect evidence; and provide explanations and interpretations, using scientific theories and concepts

- collect, verify and organize data into tables, graphs and diagrams of their own design, using written and symbolic forms; and describe findings or relationships and make predictions, using scientific vocabulary, notation, theories and models

- analyze, interpret and evaluate data that yield straight- and curved-lined graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and calculate slopes of, and areas under, straight-line graphs; and derive mathematical relationships among variables

- use mathematical language of ratio and proportion, equations, simple probability and unit analysis to solve single- and multi-step problems; and communicate scientific relationships and concepts

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Connections Among Science, Technology and Society

- apply cause and effect reasoning to formulate relationships for a range of instances in which scientific evidence shapes or refutes a theory; and explain the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples

- describe and evaluate the design and function of technological solutions to practical problems, using scientific principles or theories; and relate the ways in which biology and technology advance one another, using appropriate and relevant examples

- explain and evaluate for a given instance, and from a variety of given perspectives, how science and technology are influenced and supported by society; and assess the ability and responsibility of society, through biology and technology, to protect the environment and use natural resources wisely

- identify subject-related careers and apply the knowledge and skills acquired in Biology 30 to everyday life and to related and new concepts in post-secondary studies of biology.

SPECIFIC LEARNER EXPECTATIONS

LEARNING CYCLE

The specific learner expectations consist of the knowledge, skills and attitudes that are to be addressed in Biology 20–30. The use of the learning cycle allows students to progress, from:

- an introduction framing the lesson in an STS connection relevant to the lives of the learners, and makes connections between past and present learning experiences, as well as anticipates activities to focus students' thinking on the learning outcomes of the activity

TO

- the experiential exploration of new content that provides students with a common base of experiences within which they identify and develop key concepts, processes and skills

THROUGH

- a hypothesis-building phase where concepts are developed to describe a particular aspect of their experiential exploration, and opportunities are provided to communicate their conceptual understanding, or demonstrate their skills or behaviours

TO

- an elaboration phase that extends understanding of key concepts and allows further opportunities to practise desired skills and problem-solving strategies

TO

- an application phase where the hypotheses, vocabulary and patterns previously developed are applied to new situations and related to key concepts and principles of science

TO

- a final evaluation of the significance of the new learning in an STS context to assess their understanding and abilities, and provide opportunities for evaluation of student progress toward achieving the curriculum standards.

In Biology 20–30, students examine phenomena in a variety of topics to show the relationships among all the sciences. Wherever possible, examples should be framed in the context of the learners' own experiences to enable them to make the connections between scientific knowledge and the society around them, the technology that societies have developed, and the nature of science itself.

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PROGRAM OVERVIEW

The Biology 20–30 program emphasizes the science themes: *change, diversity, energy, equilibrium, matter* and *systems* as they relate to biology. These themes provide a means of showing the connections among the units of study in both courses of the program, and provide a framework for students to learn how individual sections of the program relate to the big ideas of science.

In addition to developing a solid understanding of fundamental science concepts and principles, Biology 20–30 has the goal of educating students about the nature of science and technology, and the interaction between biology and technology. Students must be aware of the tremendous impact of biology and associated technology on society, but at the same time, they must be aware of the roles and limitations of the biological sciences, science in general, and of technology in problem solving in a societal context.

BIOLOGY 20

The major science themes developed in this course are *diversity, energy, equilibrium, matter* and *systems*.

The major concepts allow connections to be drawn among the four units of the course and among all eight units in the two courses in the program.

Biology 20 consists of four units of study:

Unit 1: The Biosphere
Unit 2: Energy Flows and Cellular Matter
Unit 3: Energy and Matter Exchange in Ecosystems
Unit 4: Energy and Matter Exchange by the Human Organism.

Unit 1 focuses on the dynamic *equilibria* that exist for *energy* and *matter* in the biosphere, and the *systems* that regulate those *equilibria*. In Unit 2, *energy* from the environment is traced through photosynthetic and cellular respiratory *systems* with the associated cycling of *matter* in the form of carbon. Unit 3 examines the *diversity* in characteristics of some of the *ecosystems* that make up the biosphere, and the interactions of the organisms mediating the flow of *energy* and *matter* through those *ecosystems*. The unit closes with a discussion of how organisms evolve to fill available niches in *ecosystems*. The particular case of the human organism *system* and its *energy* and *matter* exchanges with the environment is examined in Unit 4, along with its biotic interactions with pathogenic organisms and the maintenance of *equilibrium* with its environment.

BIOLOGY 30

The major science themes developed in this course are *change, diversity, equilibrium* and *systems*.

The major concepts allow connections to be drawn among the four units of the course and among all eight units in the two courses in the program.

Biology 30 consists of four units of study:

Unit 1: Systems Regulating Change in Human Organisms
Unit 2: Reproduction and Development
Unit 3: Cells, Chromosomes and DNA
Unit 4: Change in Populations and Communities.

Biology 30 expands upon the concepts and skills introduced in Science 10 and Biology 20. Unit 1 focuses on chemical and electrical *systems* that regulate body processes to maintain *equilibrium*, and the processes of reproduction and development as *systems* for bringing about *change* are examined in Unit 2. Both of these units use the human organism as a model system. The themes of *change* and *diversity* run through Unit 3 as the mechanisms for passing on genetic information and causing variation, and are examined for a range of organizational levels. Finally, Unit 4 looks at *change* as illustrated by the genetics of populations, at equilibrium in populations, and at the community *systems* in which populations exist.

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BIOLOGY 20

UNIT 1
THE BIOSPHERE

OVERVIEW

Science Themes: *Energy, Equilibrium, Matter* and *Systems*

In Unit 1, students investigate the *matter* and *energy equilibrium* between photosynthetic activity and the cellular respiratory activity of living *systems*. The nature of water and other forms of *matter* as substrata for life is discussed during a survey of the hydrologic cycles and the biogeochemical cycles of several significant elements, and an examination of the roles of living *systems* in that cycling. The unit closes with a discussion of the impact of living *systems* on the *equilibrium* of atmospheric composition.

This unit builds on Science 10, Unit 1: Energy from the Sun, and Unit 2: Energy and Matter in Living Systems. It provides students with a foundation for the study of the nature of *energy* and *matter* flow at the cellular level in Unit 2, the *ecosystem* level in Unit 3, and the organism level in Unit 4.

The three **major concepts** developed in this unit are:

- the biosphere is maintained by a constant flow of *energy*
- the cycling of *matter* through the biosphere perpetuates its steady state *equilibrium*
- the balance of *energy* and *matter* exchange in the biosphere, as an open *system,* maintains its steady state *equilibrium*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning activities related to *energy* and *matter* research on the biosphere
- collecting and recording environmental data
- organizing and communicating research results
- connecting, synthesizing and integrating data or information, and interpretations related to the biosphere as a *system*.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the use of technology to solve practical problems
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate the complexity of our planet
- develop an awareness of one's personal role in the preservation of the environment
- develop a sense of responsibility toward use of our environment
- develop optimism about humankind's ability to learn to function within the limits of sustainable development
- develop an open-mindedness concerning the views and values of others
- develop an attitude of participation in planning and shaping the future
- develop an awareness of global issues and the contribution of local activity to the resolution of global problems.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. The biosphere is maintained by a constant flow of *energy*.	• most of the energy used in the biosphere comes from the Sun and is either stored or reradiated back into space, by extending from Science 10, Unit 1, the Sun's role in heating Earth, and by: • explaining how energy storage in the biosphere, as a system, can be visualized as a balance between photosynthetic and cellular respiratory activities • describing how stored biological energy in the biosphere, as a system, is eventually lost as heat; e.g., muscle heat generation, decomposition.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the biosphere is maintained by solar energy that flows through photosynthesis and respiration and is lost as heat; and by measuring and comparing solar energy variations; and performing experiments that demonstrate plant energy storage, within the context of:
• performing an experiment to demonstrate, quantitatively, solar energy storage by plants • measuring the amount of solar radiation in the local area, and comparing this with solar radiation data of other areas of the province and/or the country.	• evaluating the evidence for the influence of ice and snow on the storage of solar energy; i.e., albedo effect, hypothesizing about consequences of fluctuations for biological systems OR • explaining how metabolic heat release from harvested grain can be reduced by drying processes prior to grain storage by explaining the scientific principles involved in this technology OR • assessing the energy savings achieved in the overall requirements of large office buildings by using thermal energy recycling technologies to capture metabolic heat and the influence of the needs, interests and financial support of society in the development of these technologies OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The cycling of *matter* through the biosphere perpetuates its steady state *equilibrium*.	• specific chemical elements are cycled through the biotic and abiotic components of the biosphere, by extending from Science 10, Unit 1, the hydrologic cycle, and by: • summarizing and explaining the biogeochemical cycles for carbon, nitrogen and phosphorous • explaining how water is cycled through the biosphere along characteristic pathways • identifying the properties of water and explaining their relevance to the hydrologic cycle; e.g., freezing point, hydrogen bonding, specific heat, density.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that biosphere cycling of matter perpetuates its steady state; and by predicting and hypothesizing the human influence in these cycles; and by measuring and comparing precipitation and water movement; and designing matter exchange experiments with plants and animals, within the context of:
• predicting disruptions in nitrogen and phosphorous cycles caused by human activities	• analyzing how society affects the biogeochemical cycle of carbon, which in turn influences the greenhouse effect
	OR
• hypothesizing how alterations in the carbon cycle, as a result of the burning of fossil fuels, might influence other cycling phenomena	• discussing the influence of agricultural products or processes on the biogeochemical cycle of phosphorous and nitrogen; e.g., feedlot operations, composting, commercial fertilizer applications
	OR
• measuring the rates of precipitation and evaporation in the local area; and comparing this with precipitation and evaporation data of other areas of the province and/or the country	• evaluating the implications of the greenhouse effect on the hydrologic cycle and the water requirements of society and its agricultural systems
	OR
• designing an experiment to compare carbon dioxide production by plants with that of animals	• any other relevant context.
• measuring the rates of water consumption and loss in plants and animals.	

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. The balance of *energy* and *matter* exchange in the biosphere, as an open *system*, maintains its steady state *equilibrium*.	• air composition is influenced by the activities of organisms, by extending from Science 10, Unit 2, how energy and matter are exchanged between living systems and their environment, and by: • explaining how the equilibrium between gas exchanges in photosynthesis and cellular respiration influences atmospheric composition • describing how human activities can have a disrupting influence on the balance, in the biosphere, of photosynthetic and cellular respiratory activities; e.g., fossil fuel combustion, forest destruction.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the balance of energy and matter exchange in the biosphere and the influence of human activities on this equilibrium; and by predicting atmospheric equilibrium changes and designing models of closed systems in equilibrium, within the context of:
• predicting the effect of changes in carbon dioxide and oxygen concentration on the atmospheric equilibrium by a significant reduction of photosynthetic organisms through human activities	• discussing how the dynamic equilibrium of the atmosphere is influenced by human activity OR
• designing a model of a closed biological system in equilibrium with respect to carbon dioxide, water and oxygen exchange; e.g., space station, Biosphere II.	• examining the influence of changes to atmospheric ozone levels on society, agriculture, plants and animals OR
	• evaluating, from the past to the present, the evidence for changes in atmospheric composition, with respect to carbon dioxide and its significance to current biosphere equilibrium OR
	• evaluating the technology of a closed system; e.g., space station, Biosphere II OR
	• any other relevant context.

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UNIT 2
ENERGY FLOWS AND CELLULAR MATTER

OVERVIEW

Science Themes: *Energy, Matter* and *Systems*

In Unit 2, students study photosynthesis as the process that obtains *energy* from the environment, and cellular respiration as the process that releases it again to do useful work in cellular *systems*. The associated cyclical fluxes of carbon and other forms of *matter* within the cellular *system*, between cells or between organisms, as *systems*, are outlined in general. It is not the intent of this unit that students learn the molecular details of the Calvin–Benson and Krebs cycles.

This unit builds on prior learning in Science 10, Unit 2: Energy and Matter in Living Systems. It provides an introduction to the exchange of *energy* and *matter* within *ecosystems* as described in Unit 3, and within organisms as described in Unit 4. It also prepares students for an examination of the role of *energy* in supporting the *systems* discussed in Biology 30, Unit 1: Systems Regulating Change in Human Organisms, and Unit 2: Reproduction and Development.

The two **major concepts** developed in this unit are:

- photosynthesis stores *energy* in organic compounds
- respiration releases potential *energy* from organic compounds.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning activities that demonstrate *energy* and *matter* exchange
- collecting and recording data on photosynthetic and respiratory activity
- connecting, synthesizing and integrating cellular biochemical phenomena.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate that *energy* and *matter* may flow at very different levels of organization
- appreciate that events at the molecular level support the functioning of living *systems*
- appreciate that biologists can pursue careers involving work at very different levels of biological organization
- appreciate the contributions that the other fields of natural science can make to the biological sciences
- value the maintenance of a healthy environment to prevent the malfunctioning of the basic processes of life.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Photosynthesis stores *energy* in organic compounds.	• light energy is stored in plants when photosynthesis uses light energy to synthesize carbohydrates, by extending from Science 10, Unit 2, the structure and function of membranes, and by:
	• explaining, in general terms, how pigments absorb light, transfer that energy as reducing power in nicotinamide adenine dinucleotide, reduced form (NADH), and to chemical potential in ATP by chemiosmosis, describing where those processes occur
	• explaining, in general terms, how the products of the light reactions, NADH and ATP, are used to reduce carbon in the Calvin–Benson cycle, describing where the process occurs in the cell.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding how light energy from the Sun is stored in organic compounds by photosynthesis; and by using chromatography technology to demonstrate, quantitatively, energy storage in plants; and by drawing analogies between biological energy storage and active solar storage, within the context of:
• using chromatography techniques to demonstrate that plant leaves contain a range of pigments • using experimental data to demonstrate, quantitatively, that plant leaves produce starch in the presence of light • drawing analogies between the storage of energy by photosynthesis and the storage of energy by active solar generating systems.	• analyzing the role of photosynthesis as the biological basis of agriculture and forestry OR • researching and analyzing the effects of herbicides on the biochemistry of photosynthesis OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Respiration releases potential *energy* from organic compounds.	• cellular respiration involves the release of stored energy from carbohydrates, as well as other organic molecules, by extending from Science 10, Unit 2, growth in living systems, and by:
	• explaining, in general terms, how carbohydrates are oxidized by glycolysis and Krebs cycle to produce reducing power in NADH and flavin adenine dinucleotide, reduced form (FADH), and chemical potential in ATP, describing where in the cell those processes occur; and understanding that specific detailed knowledge of the biochemistry of the reactions is not required
	• explaining, in general terms, how chemiosmosis converts the reducing power of NADH and FADH to the chemical potential of ATP, describing where in the cell the process occurs; and understanding that specific detailed knowledge of the biochemistry of the reactions is not required
	• explaining the role of oxygen in cellular respiration; e.g., aerobic, anaerobic
	• summarizing and explaining the role of ATP in metabolism; e.g., synthesis, movement, active transport
	• explaining how environmental pollutants, like cyanide or hydrogen sulfide, inhibit cellular respiration.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that potential energy stored in organic compounds is released by cellular metabolic processes, the role of oxygen and ATP, and environmental influences on these processes; and by demonstrating, experimentally, heterotroph gas exchange; designing and performing metabolic experiments and investigating the action of metabolic toxins, within the context of:
• designing and performing an experiment to demonstrate that a byproduct of respiration in both autotrophs and heterotrophs is heat • demonstrating that respiration causes oxidation and an exchange of gases • using experimental methods to demonstrate, quantitatively, the oxygen consumption of an animal • drawing analogies between the role of ATP in a cell and money in an economic system • investigating the action of metabolic toxins, such as hydrogen sulfide, on cellular respiration.	• discussing how specific compounds released into the environment, by society, may have precise metabolic effects on humans, plants and animals, and the desirability of regulating such releases OR • assessing the impact of research in cellular biochemistry on athletic training strategies OR • researching the technology of methane gas production from organic waste, and assessing the potential impact of this technology on the societies of less developed countries OR • any other relevant context.

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UNIT 3
ENERGY AND MATTER EXCHANGE IN ECOSYSTEMS

OVERVIEW

Science Themes: *Diversity, Energy, Matter* and *Systems*

In Unit 3, students examine the biotic and abiotic factors that characterize *energy* and *matter* exchange in aquatic and terrestrial *ecosystems*. The unit closes by reviewing the process of organic evolution by natural selection. That process provides a model *system* to explain how the production of *diversity* allows for the selection of organisms better adapted to the roles they play in their *ecosystem*.

This unit builds on Biology 20, Unit 1: The Biosphere, and Unit 2: Energy Flows and Cellular Matter, providing a linkage between the biosphere and cellular phenomena by examining *energy* and *matter* flow in *ecosystems*. The unit provides the general context in which exchange between organisms and their environment are studied, and prepares students for analysis of populations and communities in Biology 30, Unit 4: Change in Populations and Communities.

The three **major concepts** developed in this unit are:

- the biosphere is composed of a *diversity* of biomes, each with distinctive biotic and abiotic factors
- *ecosystems* have characteristic structures determined by their *energy* and *matter* exchange
- populations are basic components of *ecosystem* structure.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning *ecosystem* research activities
- collecting and recording relevant data on the biotic and abiotic *ecosystem* components
- analyzing quantitative data on organism *diversity* and abiotic factors of *ecosystems*
- connecting, synthesizing and integrating the *energy* and *matter* exchange in *ecosystems* and predicting the future outcomes of those *ecosystems*.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate the *diversity* of *ecosystems*
- value the knowledge that all organisms have an important role in maintaining the life of the planet
- develop an awareness of one's personal role in the preservation of the environment
- develop a sense of responsibility toward use of the environment
- appreciate the multidimensional nature of science, technology and society issues
- appreciate the contributions and limitations of scientific and technological knowledge to societal decision making
- value the necessity of being adaptable to *changes* in the environment
- appreciate the explanatory value of the modern synthesis of the Darwinian theory of evolution to all aspects of biology at all organizational levels, as well as appreciate the limitations of the theory
- respect and tolerate the personal and religious beliefs of others.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. The biosphere is composed of a *diversity* of biomes, each with distinctive biotic and abiotic factors.	• the biosphere is composed of biomes, each with many different ecosystems, characterized by physiographic, climatic, edaphic (soil) and biotic factors, by extending from Biology 20, Unit 1, energy and matter exchange in the biosphere, and by:
	• describing how energy and matter exchange contribute to the existence of the biosphere's major biomes; e.g., tundra, taiga, deciduous forest, rain forest
	• identifying ecosystem biotic and abiotic factors and explaining their influence in an aquatic and a terrestrial ecosystem in a local region; e.g., stream or lake, prairie, boreal forest, vacant lot, sports field.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the biosphere is composed of biomes and ecosystems, each distinctly characterized by their energy and matter exchange; and by performing field studies measuring, gathering and analyzing biotic and abiotic data; evaluating resource and technology dependability; hypothesizing the ecological roles of snow and ice; and predicting future outcomes of ecosystems, within the context of:
• performing a field study and measuring, quantitatively, appropriate abiotic factors, such as temperature, precipitation, snow depth, ice thickness, light intensity, pH, hardness and oxygen content in an aquatic and a terrestrial ecosystem; and presenting the data in a form, such as graphs, tables or charts, that describe, in general terms, the abiotic structure of the ecosystem chosen	• evaluating the impact that human activity has had, or could have, on the ecosystems chosen OR
• performing a field study and gathering and analyzing both quantitative and qualitative data on the diversity of plant, animal and decomposer species in the ecosystem chosen; and presenting the data in a form that describe, in general terms, the biotic structure of the ecosystem chosen	• analyzing the needs and interests of society that may influence the natural quality of water used for human consumption OR
• hypothesizing the ecological role of biotic and abiotic factors; e.g., albedo effect, competition	• discussing the impact of "slash and burn" or "clear-cutting" practices of societies on the stability and energy flow of the ecosystem involved OR
• evaluating the dependability of resources, including technologies, used for measurement, assessment or analysis; and identifying the degree of bias in a field study.	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. *Ecosystems* have characteristic structures determined by their *energy* and *matter* exchange.	• the structure of ecosystems can be described, by extending from Biology 20, Unit 2, the relationship between photosynthesis and respiration, and by: • explaining, quantitatively, the structure of ecosystem trophic levels, using models, such as food chains and webs • explaining, quantitatively, the energy and matter exchange in ecosystems, using models, such as pyramids.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding how the nature of energy and matter exchange determines ecosystem structure and representing this information in models; and by collecting and analyzing energy and matter exchange information, and building models from this information, within the context of:
• collecting information and building a model depicting the food web of a chosen ecosystem	• discussing the impact of the draining of wetlands for reclamation and society's responsibility to use natural resources judiciously
	OR
• evaluating, quantitatively, the energy and matter exchange in a chosen ecosystem, using a pyramid of mass or numbers	• analyzing the interrelationship between the introduction of heavy metals into the environment and matter exchange in natural food chains/webs, and the impact of this on quality of life
	OR
• analyzing data on the diversity of plants, animals and decomposers that make up the biotic component of a specific endangered ecosystem; and predicting the future outcome of that ecosystem.	• researching the effect single-crop monoculture has on food webs and species diversity in the ecosystem, and the influence of the needs and interests of society on this practice
	OR
	• assessing the environmental consequences of the introduction of new species to isolated, established ecosystems and the responsibility of society, through science and technology, to protect the environment
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Populations are basic components of *ecosystem* structure.	• there is a great deal of variation within populations, by:
	• describing, in general terms, the nature of variation within populations; e.g., inherited versus acquired, continuous versus discontinuous
	• explaining how populations are adapted to their environment; e.g., drug resistance, cold tolerance
	• explaining, in general terms, how a great range of variation exists within individual populations; e.g., blood groups, enzymes
	• summarizing and describing lines of evidence to support the evolution of modern species from ancestral forms; e.g., hominids, horses
	• describing natural selection and explaining its action on future populations leading to evolutionary change.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that populations are the basic component of ecosystem structure, including range of variation, environmental adaptation and evidence supporting evolutionary change; and by designing and performing experiments to measure variation, hypothesizing adaptive significance of variations; and analyzing morphology changes over time, within the context of:
• designing and performing an experiment to measure inherited variation in a plant or animal population	• discussing the nature of science as a way of knowing, compared with other ways of knowing; e.g., origin of life
	OR
• formulating hypotheses about the adaptive significance of the variations in a range of homologous structures in extant (still existing) and extinct organisms	• describing how paleontology and the role of evidence in the accumulation of knowledge has provided invaluable data for theories explaining observable variations in organisms over time
	OR
• gathering and analyzing data, actual or simulated, on plants or animals to demonstrate how morphology evolves over time; e.g., corn, Darwin's finches, pepper moths.	• comparing society's interpretation of variations within populations and change over time with those of Darwin's era; and realizing the inability of science to provide complete answers
	OR
	• researching the contributions of Charles Lyell, Thomas Malthus and Alfred Wallace, among others, to Darwin's understanding of species change, the role of evidence in the accumulation of knowledge, and the eventual formation of Darwin's concept of natural selection and origin of species
	OR
	• any other relevant context.

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UNIT 4
ENERGY AND MATTER EXCHANGE BY THE HUMAN ORGANISM

OVERVIEW

Science Themes: *Energy, Equilibrium, Matter* and *Systems*

In Unit 4, students use the human organism as a model *system* to examine the processes that mediate the interactions between organisms and their environment. These processes maintain metabolic *equilibrium*. *Energy* and *matter* are exchanged between humans and their environment during the processes of respiration, digestion and excretion. These processes are carried out with the aid of a circulatory *system* that is also part of a defence *system*. Regulation of the interactions between pathogens and the human organism help maintain metabolic *equilibrium*.

This unit builds on learning from Science 10, Unit 1, Energy from the Sun, and Unit 2: Energy and Matter in Living Systems, and the other three units in this course. It provides a structural and functional context in which control *systems* can be studied in Biology 30, Unit 1: Systems Regulating Change in Human Organisms.

The three **major concepts** developed in this unit are:

- the human organism's digestive and respiratory *systems* exchange *energy* and *matter* with the environment
- the human organism's excretory *system* exchanges *energy* and *matter* with the environment
- the human organism's circulatory *system* transports *energy* and *matter* to maintain *equilibrium* among the body *systems* as well as between the organism and its external environment.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning activities to investigate the role of selected human organ *systems* in *energy* and *matter* exchange
- collecting and recording relevant biochemical data from a variety of physiological processes
- analyzing data and information from a variety of biochemical and physiological experiments
- connecting, synthesizing and integrating by drawing analogies among villi, alveoli, nephrons and capillaries; and by integrating information from models, simulations and research to demonstrate how *equilibrium* is maintained with respect to *energy* and *matter* exchange.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research.

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ATTITUDES

Students will be encouraged to:

- appreciate the importance of the relationship between the human organism and its environment in maintaining homeostasis
- appreciate the hierarchical organization of the human organism
- foster a curiosity about the structure and function of the human organism's *systems*, and their role in maintaining *equilibrium* with the environment
- appreciate how the digestive, respiratory, excretory, transport and defence *systems* are closely linked to cellular respiration
- develop a commitment to learning about the function of organs and *systems* in the human organism and the importance of maintaining personal health
- appreciate the complex and precise nature of the immune *system* and its sensitivity to factors like stress and infection
- appreciate the interactive nature of science and technology in developing products and processes that promote or inhibit the functioning of the human organism's *systems*
- appreciate the ethical dilemmas that may arise as a result of science and technology being used to influence the functioning of the human organism.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. The human organism's digestive and respiratory *systems* exchange *energy* and *matter* with the environment.	• human organisms, like other organisms, must exchange energy and matter by extending from Science 10, Unit 1, systems and Unit 2, concepts of surface area to volume ratio and membrane transport, and by: • describing the intake of matter from the environment, its chemical and physical processing through the digestive system into the blood stream and the return of the remaining material to the environment • explaining how gases and heat are exchanged between the human organism and its environment.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that human digestive and respiratory systems exchange energy and matter with the environment; and by observing system structure and function; designing and performing experiments identifying matter exchanged, quantifying energy exchanged, investigating enzyme function and gas exchange mechanisms, within the context of:
• observing the principal features of the digestive and respiratory systems of a mammal, using models, computer simulations or dissected organisms; and identifying the structures from drawings of those systems; e.g., villi, alveoli	• discussing and evaluating the role of food additives to solve the problems of food spoilage; e.g., antioxidants, irradiation technology OR
• performing experiments to detect the presence, in food, of organic molecules, such as carbohydrates, lipids and proteins, using qualitative chemical tests	• explaining the biological basis of nutritional deficiencies; and evaluating how diet can adversely affect the equilibrium of other body systems; e.g., anorexia nervosa OR
• designing and performing a calorimetry experiment to determine, quantitatively, the potential energy of carbohydrates and fats in foods	• assessing the physiological effect of such legal drugs as alcohol and nicotine on digestive and respiratory functions OR
• performing an experiment to demonstrate the action of digestive enzymes from plant or animal tissue; e.g., potato, liver	• evaluating the ethical implications of organ transplants in terms of the needs, interests and financial support of society on scientific and technological research in this field; e.g., societal and scientific definitions of death OR
• designing and performing experiments to investigate the influence of enzyme concentration, temperature and pH on the activity of enzymes; e.g., pepsin, pancreatin	• any other relevant context.
• designing and performing experiments to investigate the mechanics of breathing; e.g., lung volume, breathing rate.	

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The human organism's excretory *system* exchanges *energy* and *matter* with the environment.	• human organisms, like other organisms, must maintain an equilibrium with respect to their internal environment, by:
	• explaining the role of the kidney in excreting metabolic wastes from the body and expelling them into the environment
	• explaining how the excretory system maintains internal equilibrium with respect to water, pH and ions.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the role of the human excretory system in excretion of wastes and balance of water and ions; and by performing simulated urine composition experiments, analyzing data to summarize the role of the kidney; and researching the human excretory function for the purpose of designing models of kidney function, within the context of:
• performing an experiment to investigate simulated urine composition, analyzing the data and summarizing the role of the kidney in homeostatic regulation of water, pH and ionic substances	• identifying specific pathologies of the digestive, excretory, respiratory and circulatory systems, and the technology used to ease or cure the problems
	OR
• researching the human excretory system and designing a flow chart model to describe how the human organism maintains homeostasis with respect to water and ions in a situation where either the water intake was high; e.g., tea, coffee, soda pop, or where the sodium ion intake was excessive; e.g., anchovy pizza, cheese	• examining the relationships that exist among lifestyles, hypertension and kidney function
	OR
• making analogies between kidney function and renal and peritoneal dialysis.	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. The human organism's circulatory *system* transports *energy* and *matter* to maintain *equilibrium* among the body *systems* as well as between the organism and its external environment.	• human organisms must maintain an internal equilibrium with respect to organs and organ systems, as well as equilibrium with their external environment, by: • explaining the role of the circulatory system in aiding the digestive, excretory and respiratory systems' exchange of energy and matter with the environment • explaining the role of the body surface in maintenance of organism equilibrium; e.g., temperature regulation, protection from pathogens • describing the main components of blood and their role in transport, and their role in resisting the influence of pathogens; e.g., erythrocytes, leucocytes, platelets, plasma • listing main cellular and noncellular components of the human immune system and describing their role; e.g., macrophage, helper T cell, B cell, killer T cell, suppressor T cell, memory T cell.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the human circulatory system maintains an equilibrium among systems and with the external environment, exchanging thermal energy, and providing pathogen protection through the immune system and its cellular components; and by observing circulatory and excretory system morphology and capillary flow, measuring system pressure; and researching and designing immune system models, within the context of:
• observing the principal features of the circulatory and excretory systems of a mammal, using models, computer simulations or dissected organisms; and identifying the structures from drawings of those systems	• researching experimental evidence on disruptions to human circulatory equilibrium caused by severe burns OR
• summarizing, from models, computer simulations or a dissected organ, the structures and direction of blood flow through a mammalian heart	• analyzing how technological advances assist the circulatory system in the delivery of prescription drugs to their sites of action OR
• using a microscope to observe blood flow in the capillaries of a living organism; e.g., goldfish	• describing how biotechnology can assist in the maintenance of internal equilibrium with respect to pathogens OR
• performing experiments that measure venous pressure in humans	• evaluating the needs, interest and financial support society has on preventing the spread of disease-causing organisms, like *Staphylococcus*, smallpox virus and the human immunodeficiency virus (HIV) OR
• measuring and interpreting their own blood pressure; and investigating the role of exercise in influencing blood pressure	• any other relevant context.
• using a microscope to examine prepared slides of human blood to observe the morphology and relative abundance of the cellular components of the blood	
• researching and designing a simulation or model of the functioning of the main components of the human immune system.	

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BIOLOGY 30

UNIT 1
SYSTEMS REGULATING CHANGE IN HUMAN ORGANISMS

OVERVIEW

Science Themes: *Equilibrium* and *Systems*

Unit 1 uses the human organism as a model *system* to study that *equilibrium* between an organism's internal environment and its external environment can be maintained by metabolic or behavioural means. Endocrine glands and other *systems* maintain physiological *equilibrium* mediated by hormones. A study of the interaction between the neural and endocrine *systems* leads to an examination of the functioning of the central and peripheral nervous *systems* and their ability to sense the environment and respond to it. That ability is important in maintaining organism *equilibrium*.

This unit builds on Science 10, Unit 1: Energy from the Sun, Unit 2: Energy and Matter in Living Systems; and Biology 20, Unit 4: Energy and Matter Exchange by the Human Organism, by examining the biological processes that mediate the interactions between organisms and their environment to maintain a desirable *equilibrium*. This unit leads to further study of control *systems* in Unit 2, and to post-secondary studies.

The two **major concepts** developed in this unit are:

- the human organism regulates physiological processes, using electrochemical control *systems*
- the human organism maintains homeostasis through the use of complex chemical control *systems*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning activities demonstrating the human response to a variety of environmental stimuli to maintain its *equilibrium*
- collecting and recording neural and hormonal data from observations and published research
- analyzing physiological data
- connecting, synthesizing and integrating data from activities that predict the role of control *systems* in the maintenance of organism *equilibrium*
- evaluating the processes or outcomes of neural and hormonal research and identifying their limitations.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research.

ATTITUDES

Students will be encouraged to:

- foster curiosity about the structure and function of the human organism's endocrine and neural control *systems* and their role in maintaining homeostasis
- appreciate the complexity and precise nature of the neural and endocrine *systems* and the importance of their integrating functions in maintaining *equilibrium*
- develop a commitment to learning about the functioning of the neural and endocrine *systems* and the importance of maintaining personal health
- appreciate the interactive nature of science and technology in developing products and processes that promote or inhibit the functioning of the human organism's *systems*
- appreciate the ethical dilemmas that may arise as a result of science and technology being used to influence the functioning of the human organism.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. The human organism regulates physiological processes, using electrochemical control *systems*.	• the human organism, like other organisms, maintains control over its internal environment with neural systems, by extending from Science 10, Unit 1, energy systems, Science 10, Unit 2, cell processes and Biology 20, Unit 4, the biological systems that maintain the organism's equilibrium with the environment, and by: • describing the structure and function of a neuron and myelin sheath, explaining the formation and transmission of an action potential and the transmission of a signal across a synapse or neuromuscular junction and the main chemicals and transmitters involved; i.e., norepinephrine, acetylcholine and the enzyme that breaks them down • describing the composition and function of a simple reflex arc and the organization of neurons into nerves • identifying the principal structures of the central and peripheral nervous systems and explaining their functions in regulating the voluntary (somatic) and involuntary (autonomic) systems of the human organism; e.g., cerebral hemispheres, cerebellum, pons, medulla, hypothalamus, pituitary, spinal cord, sympathetic and parasympathetic nervous systems • explaining how human organisms sense their environment and their spatial orientation in it; e.g., auditory, visual, skin receptors, olfactory, proprioceptors.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding how human physiological processes are regulated by electrochemical control systems, describing the structure and function of neurons, the central and peripheral nervous systems, and sensory input transducers; and/or by observing the principal features of a neuron, mammalian brain and eye; and designing and performing experiments to investigate reflex arcs and sensory input, within the context of:
• observing neurons and neuromuscular junctions on prepared microscope slides	• analyzing experimental evidence for the influence of anesthetics, drugs and chemicals, natural and synthetic, on the functioning of the nervous system, and their relationship to addiction theories
	OR
• designing and performing experiments to investigate the physiology of reflex arcs	• discussing the biological basis of neurological diseases, like Alzheimer's or Parkinson's
	OR
• observing the principal features of the mammalian brain, using models, computer simulations or dissected mammalian brains; and identifying the major visible structures from drawings or models of that organ	• discussing how advances in science and technology have increased access to the world beyond normal sensory limits
	OR
• observing the principal features of the mammalian eye and ear, using models, computer simulations or dissected mammalian eyes; and identifying the major visible structures from drawings or models of those organs	• evaluating the application of biological knowledge in developing offensive and defensive military capabilities
	OR
• designing and performing experiments to investigate heat, cold, pressure and touch receptors, and the ability to sense environment	• discussing and evaluating the effect of science and technology on longevity and quality of life
	OR
• performing experiments to measure the ability to discriminate objects visually and to hear a range of sounds.	• evaluating the impact of photoperiod, light wavelength and duration on the human organism
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The human organism maintains homeostasis through the use of complex chemical control *systems*.	• endocrine systems coordinate other organ systems through feedback to maintain internal homeostasis as well as the organism's equilibrium with the environment, by extending from Biology 20, Unit 4, the maintenance of metabolic equilibrium, and by:
	• identifying the principal endocrine glands of the human organism; e.g., the hypothalamus/pituitary complex, thyroid and adrenal glands, pancreas islet cells
	• describing the hormones of the principal endocrine glands; i.e., TSH/thyroxine, ACTH/cortisol glucagon/ insulin, HGH, ADH, epinephrine, norepinephrine, aldosterone
	• explaining the metabolic roles hormones play in homeostasis; i.e., thyroxine to metabolism, insulin to blood sugar regulation, HGH to growth, ADH to water regulation
	• explaining how the endocrine system allows human organisms to sense their internal environment and respond appropriately; e.g., sugar metabolism
	• comparing the endocrine and neural control systems and explaining how they act together; e.g., stress and the adrenal gland
	• describing, using an example, the physiological consequences of hormone imbalances.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that homeostasis of organs and organ systems is regulated, in part, by chemical control systems; and describing the main components and hormones of the human endocrine system, their metabolic role, and their interaction with the nervous system; and by inferring and interpreting from data, the role of insulin, ADH and aldosterone; and evaluating the components of the "general adaptation syndrome", within the context of:
• inferring the role of insulin in the regulation of blood sugar, by performing an experiment to investigate the presence of reducing sugars in simulated urine; and comparing the results with urinalysis data; and/or investigating the role of insulin in the regulation of blood sugar, using a computer simulation	• evaluating the use of biotechnology to solve practical hormone problems; e.g., hormone synthesis for diabetes, dwarfism, milk yields in cows OR
• inferring the role of ADH and aldosterone in the maintenance of homeostasis of water and ions, by the analysis and interpretation of data on blood and urine composition	• comparing the function of technological control systems with electrochemical control systems in organisms; e.g., computer control systems for car emissions OR
• formulating hypotheses from published data on an environmental factor that can be detected and responded to by the human organism; e.g., ultraviolet light and pigment deposition, diet and thyroid function	• assessing the impact on athletics of research into biochemical control systems OR
• researching, identifying and summarizing the main hormonal and nervous components in stress management; i.e., "general adaptation syndrome."	• explaining the relationship among ultraviolet light, ozone depletion and pigment deposition within skin cells OR
	• discussing the use of hormone therapy in the treatment of humans; e.g., growth hormone and aging, steroids and sports OR
	• any other relevant context.

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UNIT 2
REPRODUCTION AND DEVELOPMENT

OVERVIEW

Science Themes: *Change* and *Systems*

Unit 2 studies the concept that species must reproduce themselves to ensure their survival. The processes associated with reproduction and development are reviewed here to illustrate their physiological regulation by using the human organism as a model *system*. *Change* can be induced in the reproductive and other *systems* of organisms by hormones from a variety of glands. *Change* also occurs as gametes are produced, fuse to form zygotes and undergo development. The regulation of these processes by hormonal *systems* is examined. The *systems* associated with parturition and lactation are regulated hormonally.

This unit builds upon Biology 20, Unit 4: Energy and Matter Exchange by the Human Organism; on the learning of biological control *systems* from Unit 1; and leads to a more detailed study of gametogenesis and genetics in Unit 3, and to post-secondary studies.

The three **major concepts** developed in this unit are:

- humans and other organisms have complex reproductive *systems* that ensure the survival of the species
- reproductive success of organisms is regulated by chemical control *systems*
- cell differentiation and development in the human organism are regulated by a combination of genetic, endocrine and environmental influences.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording reproductive data
- analyzing research information on hormonal data and physiological events
- connecting, synthesizing and integrating, from research information, the influence of internal and environmental factors on life span development
- evaluating the processes or outcomes of knowledge about research in human reproduction and the consequences or limitations of this research.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the ways in which science advances technology and technology advances science
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate that there are biological and societal aspects to the study of reproduction
- appreciate the association among health, reproduction and development
- appreciate the ethical dilemmas that may arise from the application of scientific research and/or technological developments to reproductive and developmental processes
- appreciate the multidimensional nature of science, technology and society issues
- respect and tolerate the personal and religious beliefs of others.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Humans and other organisms have complex reproductive *systems* that ensure the survival of the species.	• human organisms have evolved a specialized series of ducts and tubes to facilitate the union of an egg and sperm, by: • describing hormonal and chromosomal factors and explaining the physiological events resulting in the formation of the primary (gonads) and secondary (associated structures) reproductive organs in the female and male fetus • identifying the structures and describing their functions in female (e.g., ovaries, fallopian tubes, uterus, cervix, vagina) and male (e.g., testes, epididymus, vas deferens, seminal vessicles, prostate gland, penis) reproductive systems • explaining how sexually transmitted diseases can interfere with the passage of eggs and sperm; e.g., chlamydia, gonorrhea.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the development of human reproductive organs; and describing the anatomical structures that facilitate gamete union and species survival; and explaining the role of sexually transmitted diseases in this process; and by observing the principal features of human reproductive systems; and identifying eggs, sperm and supporting structures from slides, within the context of:
• observing the principal features of the human reproductive system, using models or computer simulations; and identifying the major structures from drawings of that organ system	• evaluating the implications of reproductive technology for human biology OR
• distinguishing eggs and sperm from their supporting structures, using prepared slides of ovaries and testes; e.g., interstitial cells, follicle, corpus luteum, seminiferous tubules.	• discussing society's expectations of the scientific community with respect to reproductive technology OR
	• identifying the types of physiological and physical damage caused by exposure to sexually transmitted disease organisms in females and males OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Reproductive success of organisms is regulated by chemical control *systems.*	• the development of sexual anatomy and sexual functioning is influenced by hormones, by:
	• describing the role of hormones in the regulation of primary and secondary sex characteristics in females and males
	• identifying the principal reproductive hormones in the female and explaining their interactions in the maintenance and functioning of the female reproductive system; e.g., estrogen, progesterone, LH, FSH, prolactin, oxytocin
	• identifying the principal reproductive hormones in the male and explaining their interactions in the maintenance and functioning of the male reproductive system; e.g., testosterone, luteinizing hormone (LH), follicle stimulating hormone (FSH)
	• comparing the cyclical patterns of reproduction in humans with that of nonprimate mammals.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that human reproductive success, development of secondary sexual characteristics, formation of gametes and reproductive system maintenance are regulated by hormones; and by analyzing and inferring from data and physiological events the roles of sex hormones, within the context of:
• analyzing blood hormone data and physiological events of a single menstrual cycle, and inferring the roles of the female sex hormones	• researching and assessing the effects of the medical use of reproductive hormones on humans OR
• analyzing blood hormone data and physiological events, and inferring the roles of the male sex hormones.	• explaining how reproductive hormone homeostasis is disrupted by the natural aging process OR
	• researching and assessing the value of producing and using reproductive hormones in domestic animals, such as cattle and horses OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Cell differentiation and development in the human organism are regulated by a combination of genetic, endocrine and environmental influences.	• events following conception are governed by a combination of genetic, endocrine and environmental influences, by extending from Biology 20, Unit 4, the human organism as a system, and by:
	• tracing the processes of fertilization, implantation, extraembryonic membrane formation (e.g., amnion, chorion, yolk sac, placenta), embryo development, parturition and lactation, and the control mechanisms of those events; e.g., progesterone, LH, chorionic gonadotropin, oxytocin, prolactin
	• describing fetal development from implantation to full term in the context of the main physiological events that occur in the development of organ systems during each major stage (trimester) and the influence of environmental factors on the development of these systems; e.g., alcohol, drugs, pathogens
	• describing the physiological or mechanical basis of different reproductive technology methods; e.g., conception control, in vitro fertilization, infertility reversal.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding how development from conception is regulated by genetics, hormones and environment; and describing these developmental events and the technologies that influence them; and by observing slides, models or computer simulations of nonhuman embryo development, investigating environmental influences on the embryo/fetus and assessing safety reproductive technology, within the context of:
• observing the stages of embryo development, using preserved material, such as chicken embryos, prepared slides, models or computer simulations; and extrapolating these events to the development of a human fetus	• analyzing the use of technology to solve problems of incompatibility between fetus and mother, and possible solutions to such problems OR
• investigating the effects of environmental factors, such as alcohol and nonprescription drugs, on the development of the human fetus	• assessing the societal impact of reproductive imaging technologies; e.g., ultrasound, magnetic resonance image ray (MRI), X-rays OR
• evaluating, from published data, the effectiveness and safety of the various reproductive technology methods	• discussing how knowledge of embryo/fetus development has influenced society's values on human life OR
• interpreting hormonal data from published investigations; e.g., pregnancy testing.	• discussing the societal impact of chemicals and drugs on fetal development; e.g., alcohol and cocaine OR
	• assessing the effects of hormonal conception control technology on population demographics in developed and underdeveloped countries OR
	• any other relevant context.

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UNIT 3
CELLS, CHROMOSOMES AND DNA

OVERVIEW

Science Themes: *Change* and *Diversity*

In Unit 3, students examine the cell and molecular biology of mitosis as well as its limitations in providing *diversity*. The significance of meiosis as a way by which organisms can introduce *diversity* into their descendants is introduced. The timing and location of meiosis in the reproductive biology of the human organism is discussed. The studies of classical genetics are reviewed to show how phenotypes may *change* through generations. Classical genetics is extended to a molecular level where the role of DNA in producing RNA, then proteins, is reviewed. The principles of introducing *change* into the sequence of bases in DNA is examined.

This unit builds on Science 10, Unit 2: Energy and Matter in Living Systems, where simple cell division was introduced and Biology 30, Unit 2: Reproduction and Development, where spermatogenesis and oogenesis were introduced. This unit leads to a study of population genetics in Unit 4, and to post-secondary study.

The three **major concepts** developed in this unit are:

- cells divide to increase in number but must reduce their chromosome number before combining at fertilization
- genetic characters are handed down by simple rules
- classical genetics can be explained at a molecular level.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning activities that demonstrate genetic inheritance patterns and environments
- collecting and recording empirical data on single gene inheritance, cell division and information from computer simulations and models
- analyzing published and collected genetic information for trends, patterns and relationships
- connecting, synthesizing and integrating various types of genetic and cellular information.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- be open-minded toward new evidence, and be aware of the *changes* it may promote
- appreciate that extension of learning requires new knowledge, skills, attitudes and risk taking
- value the development of information, science and technology, while continuing to cultivate human values
- appreciate the usefulness of computational competence and the problem-solving skills required by classical genetics
- develop a positive attitude toward mathematical and scientific process skills
- appreciate the ethical dilemmas that may arise from the application of scientific research and/or technological developments as they relate to the field of genetics
- appreciate, and be critical about, current research and theories concerning genetic information.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Cells divide to increase in number but must reduce their chromosome number before combining at fertilization.	• chromosomes are duplicated before cells divide; that daughter cells get one complete set of chromosomes; that chromosome number must be reduced before fertilization; and that variations in the combination of genes on a chromosome can occur during that reduction, by recalling from Science 10, Unit 2, that growth may involve increasing cell number, and by: • explaining, in general, the events of the cell cycle, including cytokinesis, and chromosomal behaviour in mitosis and meiosis • describing the processes of spermatogenesis and oogenesis and the necessity for chromosomal number reduction in meiosis • describing the processes of nondisjunction and crossing over; and evaluating their significance on organism development • comparing the processes of mitosis and meiosis • comparing the formation of fraternal and identical offspring in a single birthing event • describing the diversity of reproductive strategies by comparing the alternation of generations in a range of plants and animals; i.e., pine, bee, mammal.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that mitosis results in cell division and genetic continuity, and meiosis results in gamete formation and genetic variation; and by observing actively dividing cells, performing meiosis simulations and researching reproductive strategies in plants and animals, within the context of:
• identifying the stages of the cell cycle; and calculating the duration of each stage from observations of prepared slides of onion root tip cells	• discussing the role of mitosis and biotechnology in regenerating damaged or missing parts of organisms OR
• preparing microscope slides to demonstrate some stages of mitosis and meiosis	• evaluating how a knowledge of cell division might be applied to the limitation of cancerous growth in plants or animals OR
• performing a simulation to demonstrate the behaviour of chromosomes during meiosis	• discussing the types and sources of various teratogenic compounds found in the environment and the responsibility of society, through science and technology, to ensure quality of life for future generations OR
• researching a range of reproductive strategies in seed plants and animals; and presenting this information in the form of charts, tables or diagrams; e.g., budding, spore production, binary fission	• evaluating the impact of research in plant and animal reproduction on our understanding of mitosis and meiosis in humans OR
• preparing and interpreting models of human karyotypes.	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Genetic characters are handed down by simple rules.	• chromosomes consist of a sequence of genes and their alleles, and that during meiosis and fertilization these genes become combined in new sequences, by extending from Biology 30, Unit 2, fertilization and development in the human organism, and by: • describing the evidence for the segregation of genes and the independent assortment of genes on different chromosomes, as investigated by Mendel • explaining the influence of crossing over on the assortment of genes on the same chromosome; e.g., gene linkage • explaining the significance of sex chromosomes compared to autosomes, as investigated by Morgan.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding how genetic characters are handed down by simple rules; and describing evidence for gene segregation and explaining the significance of crossing over and sex chromosomes; and by drawing and interpreting pedigree charts; and performing simulations or experiments to predict inheritance patterns, within the context of:
• performing experiments to investigate the relationships between chance and genetic inheritance	• evaluating, from a variety of perspectives, the needs and interests of society and the role of genetic counselling in the identification and treatment of potentially disabling genetic disorders; e.g., phenylketonuria
	OR
• performing simulations to investigate monohybrid and dihybrid genetic crosses, by using Punnett squares	• discussing the role of gene banks used to preserve endangered species and genotypes, particularly of plants and animals used in agriculture; and the responsibility of society to protect the environment for future generations
	OR
• designing a procedure and collecting data in peer groups or families to demonstrate the presence of single and multiple alleles in human inheritance	• discussing biotechnology and gene replacement therapy in the treatment of human genetic disorders
	OR
• drawing and interpreting pedigree charts from data on human single allele and multiple allele inheritance patterns; e.g., blood types	• any other relevant context.
• predicting, quantitatively, the probability of inheritance from monohybrid, dihybrid and sex-linked inheritance data	
• designing and performing an experiment to demonstrate the inheritance pattern of a trait controlled by a single pair of genes.	

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Classical genetics can be explained at a molecular level.	• genetic information in chromosomes is translated into protein structure; that the information may be manipulated; and that the manipulated information may be used to transform cells, by:
	• summarizing the historical events that led to the discovery of the structure of the DNA molecule, as described by Watson and Crick
	• describing, in general, how genetic information is contained in the sequence of bases in DNA molecules in chromosomes; how the DNA molecules replicate themselves; how the information is transcribed into sequences of bases in RNA molecules and is finally translated into sequences of amino acids in proteins
	• explaining, in general, how restriction enzymes and ligases may cut DNA molecules into smaller fragments and reassemble them with new sequences of bases
	• explaining, in general, how cells may be transformed by inserting new DNA sequences into their genomes
	• explaining how a random change (mutation) in the sequence of bases provides a source of genetic variability
	• explaining how information in nucleic acids contained in the nucleus, mitochondria and chloroplasts gives evidence for the relationships among organisms of different species.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding how DNA structure and function can explain classical genetics; and explaining DNA manipulation, mutations and DNA evidence for organism relationships; and by predicting gene sequences; designing and constructing DNA models; performing experiments to demonstrate DNA expression; and analyzing and inferring the relationship between human activities and mutations, within the context of:
• predicting the general arrangement of genes in a chromosome, from analysis of data on crossing over between genes in a single pair of chromosomes	• evaluating the use of genetically engineered organisms in agriculture and forestry; and bioremediation in the natural environment
	OR
• designing and constructing models of DNA to demonstrate the general structure and base arrangement	• debating the societal and scientific definitions of life and the living condition
	OR
• performing simulations to demonstrate the replication of DNA and the transcription and translation of its information	• discussing the Human Genome Project in terms of the needs, interests and financial support of society
	OR
• designing and performing an experiment to demonstrate how an environmental factor can cause a change in the expression of genetic information of an organism	• discussing the implications to society of corporations being able to patent new life forms produced by biotechnology
	OR
• performing simulations to demonstrate the use of restriction enzymes and ligases in creating new DNA sequences; e.g., electrophoresis	• assessing the impact of DNA mapping technology on the study of genetic relationships and variations in population ecology
	OR
• analyzing and inferring, from published data, the relationship between human activities and changes in genetic information, that lead to inheritable mutations and cancer.	• any other relevant context.

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UNIT 4
CHANGE IN POPULATIONS AND COMMUNITIES

OVERVIEW

Science Themes: *Change, Equilibrium* and *Systems*

Unit 4 introduces students to genetic principles that may be used to analyze population *systems*, and an example is drawn with the Hardy–Weinberg *equilibrium*. The reasons for populations not being in *equilibrium* are reviewed. Population growth and growth strategies are discussed. The interactions of organisms in human or natural *systems*, and the consequences of such interactions for populations and communities in those *systems*, are investigated. Populations of different organisms exist in communities that may *change* over time as a result of natural or artificial events. A review of such successional events completes the unit.

This unit builds on the learning from Biology 20, Unit 3: Energy and Matter Exchange in Ecosystems. This unit, the course and the program, may lead to careers or post-secondary study in the biological sciences.

The three **major concepts** developed in this unit are:

- communities are made up of populations that consist of pools of genes from the individuals of a species
- individuals of populations interact with each other and members of other populations
- population *change* over time can be expressed in quantitative terms.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning activities to demonstrate population growth and *change* over time
- collecting and recording empirical data on population and community *change*
- analyzing published data, collected data and information from computer simulations and models
- connecting, synthesizing and integrating *ecosystem* information from a variety of sources to interpret and explain community *change* and *equilibrium*.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of products or processes based on scientific principles
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- be open-minded toward new evidence and be aware of the *changes* it may promote
- appreciate the usefulness of computational competence and problem-solving skills required by population genetics
- develop a positive attitude toward mathematical and scientific process skills
- appreciate the *diversity* in populations and communities
- appreciate that *change* occurs in populations and communities over very long and short time scales

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- value the knowledge that all organisms have an important role in maintaining the life of the planet
- develop optimism about the human ability to learn to function within the limits of sustainable development
- develop an attitude of participation in planning and shaping the future
- appreciate the contributions and limitations of scientific and technological knowledge to societal decision making.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Communities are made up of populations that consist of pools of genes from the individuals of a species.	• populations can be defined in terms of their gene pools, by extending from Biology 20, Unit 3, the nature of variation and adaptation in populations, and by:
	• describing the Hardy–Weinberg principle and explaining its importance to population gene pool stability and the significance of nonequilibrium values; e.g., evolution of a population
	• describing the conditions that cause the gene pool diversity to change; e.g., random genetic drift, gene migration, differential reproduction
	• applying, quantitatively, the Hardy–Weinberg principle to observed and published data
	• describing the molecular basis and significance of gene pool change over time; i.e., mutations.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that communities consist of population-specific gene pools; and explaining the significance of the Hardy–Weinberg principle and the molecular basis of gene pool change over time; and by applying and interpreting the Hardy–Weinberg principle, and performing experiments to demonstrate population growth, within the context of:
• calculating and interpreting problem-solving exercises involving the Hardy–Weinberg principle expressed as $p^2 + 2pq + q^2 = 1$	• discussing the implications of the introduction of exotic species into an ecosystem where natural predators do not exist, and methods to deal with situations arising therefrom
	OR
• performing experiments and/or computer simulations to demonstrate population growth and gene pool change.	• debating the role of ecological reserves in preserving our natural heritage
	OR
	• assessing the role and importance of models in science to explain observable phenomena; e.g., the Hardy–Weinberg principle
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Individuals of populations interact with each other and members of other populations.	• interactions occur among members of the same population of a species as well as among members of populations of different species, by: • describing the basis of symbiotic relationships, i.e., commensalism, mutualism, parasitism, and interspecific and intraspecific competition and their influences on population changes • describing the relationships between predator and prey species and their influence on population changes; and explaining the role of defence mechanisms in predation; e.g., mimicry, protective colouration • explaining how mixtures of populations that define communities may change over time or remain as a climax community; e.g., primary succession, secondary succession.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that individuals interact with each other and other populations, and that communities and their populations change over time; and by summarizing and evaluating relationships; and by performing predatory–prey simulations; and designing and performing experiments demonstrating biotic interactions, within the context of:
• summarizing and evaluating the symbiotic relationship between a parasite and its host	• discussing the implications of the predator–prey relationship for wildlife management in national and provincial parks
	OR
• designing and performing an experiment to demonstrate interspecific and/or intraspecific competition	• investigating the long-term implications of ecosystem fire control and prevention on population and ecosystem stability and diversity
	OR
• performing simulations to investigate the relationships between predators and their prey	• analyzing the relationship between parasites and human developmental potential in less developed countries
	OR
• designing and performing an experiment to demonstrate succession in a micro-environment, and recording its pattern of succession over time.	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Population *change* over time can be expressed in quantitative terms.	• populations grow in characteristic ways, and that the changes in population growth can be quantified, by extending from Biology 20, Unit 3, variations within populations, and by: • describing and explaining, quantitatively, factors that influence population growth; i.e., mortality, natality, immigration, emigration • describing the growth of populations in terms of the mathematical relationship among carrying capacity, biotic potential and the number of individuals in the population • explaining, quantitatively, the behaviour of populations, using different growth patterns; i.e., r- and K-strategies, J and S curves • describing the implications of the chaos theory for the study of biological systems, especially as they relate to population growth patterns.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that populations have characteristic growth patterns, and these changes can be expressed quantitatively; and by graphing and interpreting population growth data; designing and performing experiments demonstrating environmental influence; and researching the chaos theory, within the context of:
• graphing and interpreting population growth data on a variety of organisms • designing and performing an experiment to demonstrate the affect of environmental factors on population growth • researching the chaos theory, and hypothesizing its application to biological systems.	• analyzing the growth of human populations and comparing them with the naturally occurring populations of other species OR • evaluating the implications for natural systems inherent in the chaos theory OR • developing appropriate investigative strategies for dealing further with biological problems; e.g., risk/benefit analysis, cost/benefit analysis OR • any other relevant context.

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CHEMISTRY 20–30

A. PROGRAM OVERVIEW

RATIONALE AND PHILOSOPHY

Chemistry is the study of matter and its changes. Through the study of chemistry, learners are given an opportunity to explore and understand the natural world and to become aware of the profound influence of chemistry in their lives. Learning is facilitated by relating the study of chemistry to what the learners already know, deem personally useful and consider relevant. Learning proceeds best when it originates from a base of concrete experiences presenting an authentic view of science in the context of chemistry. In Chemistry 20–30, students learn chemistry in relevant contexts and engage in meaningful activities. This facilitates the transfer of knowledge to new contexts. Students are encouraged to participate in lifelong learning about chemistry and to appreciate it as a scientific endeavour with practical impact on their own lives and on society as a whole.

Chemistry, as with all sciences, is an experimental discipline requiring creativity and imagination. Methods of inquiry characterize its study. In Chemistry 20–30, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop their critical thinking skills. Through experimentation, and problem-solving activities that include the integration of technology and independent study, students develop an understanding of the processes by which scientific knowledge evolves.

The Chemistry 20–30 program places students at the centre. Students are active learners and will assume increased responsibility for their learning as they work through the program. A thorough study of chemistry is required to give students an understanding that encourages them to make appropriate applications of scientific concepts to their daily lives and prepares them for future studies in chemistry. Students are expected to participate actively in their own learning. An emphasis on the key concepts and principles of chemistry provides students with a more unified view of the sciences and a greater awareness of the connections among them.

These science learnings will take varying amounts of time to acquire, depending on the individual learning styles and abilities of students. While each course is designed for approximately 125 hours, instructional time can be modified to meet the individual needs of students. Some students will require more than 125 hours, while others will require less.

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GOALS

The major goals of the Chemistry 20–30 program are:

- to develop in students an understanding of the interconnecting ideas and principles that transcend and unify the natural science disciplines
- to provide students with an enhanced understanding of the scientific world view, inquiry and enterprise
- to help students attain the level of scientific awareness essential for all citizens in a scientifically literate society
- to help students make informed decisions about further studies and careers in science
- to provide students with opportunities for acquiring knowledge, skills and attitudes that contribute to personal development.

Chemistry 20–30 is an academic program that helps students better understand and apply fundamental concepts and skills. The focus is on helping students understand the chemistry principles behind the natural events they experience and the technology they use in their daily lives. The program encourages enthusiasm for the scientific enterprise and develops positive attitudes about chemistry as an interesting human activity with personal meaning. It develops in students the knowledge, skills and attitudes to help them become capable of, and committed to, setting goals, making informed choices and acting in ways that will improve their own lives and life in their communities.

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B. LEARNER EXPECTATIONS

GENERAL LEARNER EXPECTATIONS

The general learner expectations outline the many facets of scientific awareness and serve as the foundation for the specific learner expectations covered in section C. The general learner expectations are developed in two categories: *program* expectations and *course* expectations.

PROGRAM GENERAL LEARNER EXPECTATIONS

The *program* general learner expectations are broad statements of science attitudes, knowledge, skills and science, technology and society (STS) connections that students are expected to achieve in all of the senior high school science programs. These *program* general learner expectations are further refined through the *course* general learner expectations and then developed in specific detail through the study of individual units in each of Chemistry 20 and Chemistry 30. All expectations follow a progression from Science 10 through to Chemistry 30, and though listed separately, are meant to be developed in conjunction with one another, within a context.

ATTITUDES

Students will be encouraged to develop:

- enthusiasm for, and a continuing interest in, science
- affective attributes of scientists at work; such as, respect for evidence, tolerance of uncertainty, intellectual honesty, creativity, perseverance, cooperation, curiosity and a desire to understand
- positive attitudes toward scientific and technological skills involving process skills, mathematics, and problem solving
- open-mindedness and respect for the points of view of others
- sensitivity to the living and nonliving environment
- appreciation of the roles of science and technology in our understanding of the natural world.

KNOWLEDGE

Science Themes

Students will be expected to demonstrate an understanding of themes that transcend the discipline boundaries, and show the unity among the natural sciences, including:

- Change: how all natural entities are modified over time, how the direction of change might be predicted and, in some instances, how change can be controlled
- Diversity: the array of living and nonliving forms of matter and the procedures used to understand, classify and distinguish those forms on the basis of recurring patterns
- Energy: the capacity for doing work that drives much of what takes place in the Universe through its variety of interconvertible forms
- Equilibrium: the state in which opposing forces or processes balance in a static or dynamic way
- Matter: the constituent parts, and the variety of states of the material in the physical world
- Systems: the interrelated groups of things or events that can be defined by their boundaries and, in some instances, by their inputs and outputs.

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SKILLS

Students will be expected to develop an ability to use thinking processes associated with the practice of science for understanding and exploring natural phenomena, problem solving and decision making. Students will also be expected to use teamwork, respect the points of view of others, make reasonable compromises, contribute ideas and effort, and lead when appropriate to achieve the best results. These processes involve many skills that are to be developed within the context of the program content.

Students will also be expected to be aware of the various technologies, including information technology, computer software and interfaces that can be used for collecting, organizing, analyzing and communicating data and information.

The skills framework presented here assumes that thinking processes often begin with an unresolved problem or issue, or an unanswered question. The problem, issue or question is usually defined and hypotheses formulated before information gathering can begin. At certain points in the process, the information needs to be organized and analyzed. Additional ideas may be generated—for example, by prediction or inference—and these new ideas, when incorporated into previous learning, can create a new knowledge structure. Eventually, an outcome, such as a solution, an answer or a decision is reached. Finally, criteria are established to judge ideas and information in order to assess both the problem-solving process and its outcomes.

The following skills are not intended to be developed sequentially or separately. Effective thinking is nonlinear and recursive. Students should be able to access skills and strategies flexibly; select and use skills, processes or technologies that are appropriate to the tasks; and monitor, modify or replace them with more effective strategies.

- Initiating and Planning
  - identify and clearly state the problem or issue to be investigated
  - differentiate between relevant and irrelevant data or information
  - assemble and record background information
  - identify all variables and controls
  - identify materials and apparatus required
  - formulate questions, hypotheses and/or predictions to guide research
  - design and/or describe a plan for research, or to solve a problem
  - prepare required observation charts or diagrams, and carry out preliminary calculations
- Collecting and Recording
  - carry out the procedure and modify, if necessary
  - organize and correctly use apparatus and materials to collect reliable data
  - observe, gather and record data or information accurately according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations
- Organizing and Communicating
  - organize and present data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
  - communicate data effectively, using mathematical and statistical calculations, where necessary
  - express measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
  - communicate findings of investigations in a clearly written report
- Analyzing
  - analyze data or information for trends, patterns, relationships, reliability and accuracy
  - identify and discuss sources of error and their affect on results

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- identify assumptions, attributes, biases, claims or reasons
- identify main ideas

- Connecting, Synthesizing and Integrating

  - predict from data or information, and determine whether or not these data verify or falsify the hypothesis and/or prediction
  - formulate further, testable hypotheses supported by the knowledge and understanding generated
  - identify further problems or issues to be investigated
  - identify alternative courses of action, experimental designs, and solutions to problems for consideration
  - propose and explain interpretations or conclusions
  - develop theoretical explanations
  - relate the data or information to laws, principles, models or theories identified in background information
  - propose solutions to a problem being investigated
  - summarize and communicate findings
  - decide on a course of action

- Evaluating the Process or Outcomes

  - establish criteria to judge data or information
  - consider consequences and biases, assumptions and perspectives
  - identify limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used
  - evaluate and suggest alternatives and consider improvements to the experimental technique and design, the decision-making or the problem-solving process
  - evaluate and assess ideas, information and alternatives

CONNECTIONS AMONG SCIENCE, TECHNOLOGY AND SOCIETY

Science, Technology and Society (STS)

Students will be expected to demonstrate an understanding of the processes by which scientific knowledge is developed, and of the interrelationships among science, technology and society, including:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of processes or products based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

FURTHER READING

For a more detailed discussion on how to integrate thinking and research skills into the science classroom, refer to the publications: *Teaching Thinking: Enhancing Learning*, 1990 and *Focus on Research: A Guide to Developing Students' Research Skills*, 1990.

For further reading on integrating science, technology and society into the classroom, refer to the publication: *STS Science Education: Unifying the Goals of Science Education,* 1990.

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COURSE GENERAL LEARNER EXPECTATIONS

The *course* general learner expectations are specific to each of Chemistry 20 and Chemistry 30 providing a bridge between the *program* general learner expectations and the specific learner expectations for each unit of study.

The attitudes expectations refer to those predispositions that are to be fostered in students. These expectations encompass attitudes toward science, the role of science and technology, and the contributions of science and technology toward society. The knowledge expectations are the major chemistry concepts in each course. The skills expectations refer to the thinking processes and abilities associated with the practice of science, including understanding and exploring natural phenomena, and problem solving. The connections among science, technology and society expectations focus on: the processes by which scientific knowledge is developed; the interrelationships among science, technology and society; and links each course to careers, everyday life and subsequent studies of chemistry.

Although itemized separately, the attitudes, knowledge, skills and STS connections are meant to be developed together within one or more contexts.

Chemistry 20–30

Attitudes

Students will be encouraged to:

- appreciate the role of empirical evidence and models in science, and accept the uncertainty in explanations and interpretations of observed phenomena
- value the curiosity, openness to new ideas, creativity, perseverance and cooperative hard work required of scientists, and strive to develop these same personal characteristics
- appreciate the role of science and technology in advancing our understanding of the natural world, be open-minded and respectful of other points of view when evaluating scientific information and its applications, and appreciate that the application of science and technology by humankind can have beneficial as well as harmful effects and can cause ethical dilemmas
- show a continuing interest in science, appreciate the need for computational competence, problem-solving and process skills when doing science, and value accuracy and honesty when communicating the results of problems and investigations
- value the need for safe handling, storing and disposing of chemicals and materials with care for the environment.

Chemistry 20

Students will be able to:

Knowledge

- apply the principles of energy and matter conservation to chemical systems undergoing change; and use direct evidence and generalizations to predict the outcomes of chemical change; and relate chemical change principles to a variety of reaction applications
- analyze physical, chemical and biological systems in terms of energy and matter forms, transfers, movement and conservation
- explain the interrelationship between energy and chemical changes to matter and how energy is either released or absorbed as chemical bonds are rearranged and new substances are formed; and describe the practical applications of exothermic and endothermic changes

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- explain chemical changes to matter; and write balanced chemical equations to describe transformations and analyze them, quantitatively and qualitatively, to make predictions about the products formed or reactants consumed; and apply this knowledge to stoichiometric calculations in a variety of everyday and industrial situations

- describe solution systems, including acids, bases and gases, quantitatively and qualitatively, and relate their properties to their uses

- describe the diverse forms of matter, using models to illustrate bonding and structure, and using theories to explain the properties and behaviour of a variety of elements and organic and inorganic compounds and solutions, including acids, bases and gases

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

- analyze and interpret data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and derive from graphs mathematical relationships among variables

- use mathematical language of ratio and proportion, numerical and algebraic methods, gravimetric and solution stoichiometry and unit analysis to solve single- and multi-step problems; and to communicate scientific relationships and concepts

Connections Among Science, Technology and Society

- apply cause and effect reasoning to formulate simple relationships for a given instance in which scientific evidence shapes or refutes a theory; and describe the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which chemistry and technology advance one another, using appropriate and relevant examples

- explain for a given instance how science and technology are influenced and supported by society, and the responsibility of society, through chemistry and technology, to protect the environment and use natural resources wisely

- identify subject-related careers and apply the knowledge and skills acquired in Chemistry 20 to everyday life and to related and new concepts in subsequent studies of chemistry.

Chemistry 30

Students will be able to:

Knowledge

- apply the principles of energy and matter conservation to chemical systems undergoing change; and use direct and indirect evidence and theoretical knowledge to predict the outcomes of chemical change; and relate chemical change principles to a broad range of reaction applications

- analyze and evaluate biological, chemical and physical systems in terms of energy and matter forms, transfers, movement and conservation

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- explain the interrelationship between energy and physical, chemical and nuclear changes to matter by describing how the rearrangement of bonds results in the release or absorption of energy; and evaluate society's production and use of energy from fossil fuels and nuclear fission

- analyze and explain, quantitatively and qualitatively, the transfer of electrons, and the energy and matter transformations that take place in electrochemical systems; and write balanced oxidation–reduction equations; and describe applications of oxidation–reduction reactions in electrochemical and electrolytic cells

- describe chemical equilibrium systems for acids, bases and gases, quantitatively and qualitatively, and describe some applications

- explain the Brønsted–Lowry concept of acids and bases; and, quantitatively and qualitatively, describe acid and base solutions in a variety of ways; and write and analyze reaction equations; and perform calculations and interpretations from titration data

Skills

- perform and evaluate investigations and tasks of their own and others' design that have multiple variables and yield direct or indirect evidence; and provide explanations and interpretations, using scientific theories and concepts

- collect, verify and organize data into tables, graphs and diagrams of their own design, using written and symbolic forms; and describe findings or relationships and make predictions, using scientific vocabulary, notation, theories and models

- analyze, interpret and evaluate data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and derive from graphs mathematical relationships among variables

- use mathematical language of ratio and proportion, numerical and algebraic methods, and unit analysis to solve multi-step, nonroutine problems; and communicate scientific relationships and concepts

Connections Among Science, Technology and Society

- apply cause and effect reasoning to formulate relationships for a range of instances in which scientific evidence shapes or refutes a theory; and explain the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples

- describe and evaluate the design and function of technological solutions to practical problems, using scientific principles or theories; and relate the ways in which chemistry and technology advance one another, using appropriate and relevant examples

- explain and evaluate for a given instance, and from a variety of given perspectives, how science and technology are influenced and supported by society; and assess the ability and responsibility of society, through chemistry and technology, to protect the environment and use natural resources wisely

- identify subject-related careers and apply the knowledge and skills acquired in Chemistry 30 to everyday life and to related and new concepts in post-secondary studies of chemistry.

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SPECIFIC LEARNER EXPECTATIONS

LEARNING CYCLE

The specific learner expectations consist of the knowledge, skills and attitudes that are to be addressed in Chemistry 20–30. The use of the learning cycle allows students to progress, from:

- an introduction framing the lesson in an STS connection relevant to the lives of the learners, and makes connections between past and present learning experiences, as well as anticipates activities to focus students' thinking on the learning outcomes of the activity

TO

- the experiential exploration of new content that provides students with a common base of experiences within which they identify and develop key concepts, processes and skills

THROUGH

- a hypothesis-building phase where concepts are developed to describe a particular aspect of their experiential exploration, and opportunities are provided to communicate their conceptual understanding, or demonstrate their skills or behaviours

TO

- an elaboration phase that extends understanding of key concepts and allows further opportunities to practise desired skills and problem-solving strategies

TO

- an application phase where the hypotheses, vocabulary and patterns previously developed are applied to new situations and related to key concepts and principles of science

TO

- a final evaluation of the significance of the new learning in an STS context to assess their understanding and abilities, and provide opportunities for evaluation of student progress toward achieving the curriculum standards.

In Chemistry 20–30, students examine phenomena in a variety of topics to show the relationships among all the sciences. Wherever possible, examples should be framed in the context of the learners' own experiences to enable them to make the connections between scientific knowledge and the society around them, the technology that societies have developed, and the nature of science itself.

PROGRAM OVERVIEW

The Chemistry 20–30 program emphasizes the science themes: *change, diversity, energy, equilibrium, matter* and *systems* as they relate to chemistry. These themes provide a means of showing the connections among the units of study in both courses of the program, and provide a framework for students to learn how individual sections of the program relate to the big ideas of science.

In addition to developing a solid understanding of fundamental science concepts and principles, Chemistry 20–30 has the goal of educating students about the nature of science and technology, and the interaction between chemistry and technology. Students must be aware of the tremendous impact of chemistry and associated technology on society, but at the same time, they must be aware of the roles and limitations of the chemistry sciences, science in general, and of technology in problem solving in a societal context.

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CHEMISTRY 20

Chemical *change* and *matter* are the themes common to all the units in Chemistry 20. An understanding of the nature of *matter* and an analysis of its *changes* is essential for understanding what is happening and for predicting what will happen; control of *change* is essential for the design of technological *systems*. The principles of conservation of mass and *energy* help to predict and explain the *changes* that occur in a closed *system*. Chemistry 20 students are developmentally ready to begin defining *matter* in conceptual terms. Observations that provide evidence to support theories are stressed through experimentation and linking empirical and theoretical knowledge.

The major concepts allow connections to be drawn among the four units of the course and among all seven units in the two courses in the program.

Chemistry 20 consists of four units of study:

Unit 1: Matter as Solutions, Acids, Bases and Gases
Unit 2: Quantitative Relationships in Chemical Changes
Unit 3: Chemical Bonding in Matter
Unit 4: The Diversity of Matter: An Introduction to Organic Chemistry.

Each unit in Chemistry 20 uses a different context to investigate the nature of *matter*; to identify common patterns and the processes by which *matter* and *systems* are modified. Unit 1 focuses on the nature of *matter*, specifically solutions and gases, by examining their properties, identifying patterns and analyzing *changes* in these *systems*. In Unit 2, the quantitative relationships in chemical reaction *systems* are explored in predicting masses of substances reacted or produced as a result of chemical *change*. In Unit 3, models of the atom are extended to models of bonding as the properties of *matter* and theoretical explanations about its behaviour are linked. In Unit 4, examples of the *diverse* forms of organic compounds are investigated and compared with inorganic *matter*. *Change* as it relates to chemical reactions of organic compounds in living and nonliving systems is also examined.

CHEMISTRY 30

The themes of *change*, *energy* and *systems* are central in Chemistry 30. *Equilibrium* and *matter* are subordinate themes that are also addressed. The components of a *system*, which may be a collection of substances or processes, influence each other by the transfer of *energy* and *matter*. Changes to one part result in *changes* to other parts of the system. In a system at *equilibrium*, opposing reactions are balanced.

The major concepts allow connections to be drawn among the three units of the course and among all seven units in the two courses in the program.

Chemistry 30 consists of three units of study:

Unit 1: Thermochemical Changes
Unit 2: Electrochemical Changes
Unit 3: Equilibrium, Acids and Bases in Chemical Changes.

Chemistry 30 expands upon the concepts and skills introduced in Science 10 and Chemistry 20. Each unit in Chemistry 30 uses a different context to investigate the nature of chemical *change*. The themes are addressed using examples from inorganic and organic chemistry to emphasize the unity of science. *Energy*, as it relates to chemical *change*, is the focus of Unit 1. *Energy* as heat is most commonly absorbed or released in chemical reactions. Thermochemistry is the study of these heat *changes*. *Changes* in physical and nuclear *systems* are briefly explored for comparison. In Unit 2, *changes* in electrochemical *systems* are examined, oxidation–reduction reactions are analyzed, and the *energy* and *matter* involved are quantified. In Unit 3, the focus is on chemical *systems* at *equilibrium*. Few chemical reactions proceed in only one direction; most are somewhat reversible. Chemical *systems* involving acids and bases are studied as examples of chemical *changes* at *equilibrium*.

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CHEMISTRY 20

UNIT 1
MATTER AS SOLUTIONS, ACIDS, BASES AND GASES

OVERVIEW

Science Themes: *Change, Matter* and *Systems*

In Unit 1, students gain an insight into the nature of *matter* through an investigation of *change* in the context of solutions, including acids, bases and gases. Viewing models of *matter* as *systems* undergoing *change* aids in their understanding of the underlying structure of *matter.*

This unit builds on Science 7, Unit 4: Temperature and Heat Measurement; Science 8, Unit 1: Solutions and Substances; Science 9, Unit 5: Chemical Properties and Changes; Science 10, Unit 1: Energy from the Sun, Unit 3: Energy and Matter in Chemical Change, and on Unit 4: Change and Energy. It provides students with a foundation for the study of stoichiometry and bonding in Chemistry 20 and electrochemistry, acids and bases in Chemistry 30.

The three **major concepts** developed in this unit are:

- solutions are homogeneous mixtures of pure substances
- acids and bases have an affect on aqueous *systems*
- a model of the gaseous state of *matter* provides insight into molecular behaviour.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording data according to safety and environmental considerations
- organizing and communicating data
- evaluating the process or outcomes of the design of investigations into the properties of and *changes* to *matter.*

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- develop a questioning attitude and a desire to understand more about *matter*
- appreciate that scientific evidence is the foundation for generalizations and explanations about *matter*
- develop an awareness of the importance of water as a medium for chemical *change*
- value the need for safe handling, storing and disposing of chemicals and materials
- respect the usefulness of models and theories that are used to explain natural phenomena relating to the behaviour of gases
- develop an interest in the role of solutions, acids, bases and gases in daily life
- appreciate that our understanding of *matter* has been enhanced by the evidence obtained from the application of technology, particularly instruments for making measurements and managing data.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Solutions are homogeneous mixtures of pure substances.	• the composition of solutions can be accurately described, by extending from Science 8, Unit 1, and Science 10, Unit 1 and Unit 3, the meaning of solute, solvent, dissolving, solution, solubility and the properties of water, and by: • providing examples, from living and nonliving systems, of how dissolving substances in water is often a prerequisite for chemical change • differentiating between electrolytes and nonelectrolytes • defining concentration in terms of molarity (moles per litre of solution) • using simple calculations to show different ways of expressing concentration; e.g., per cent by mass and volume, parts per million (ppm) • outlining the steps required to prepare a solution and a dilution of a solution • describing an equilibrium system in a saturated solution in terms of equal rates of dissolving and crystallization.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding solutions and their significance in living and nonliving systems; and ways of expressing and calculating concentration; and preparing solutions, using qualitative tests to identify solutions and ions in solution, within the context of:
• using a simple conductivity apparatus to perform an experiment to identify solutions	• providing examples of how solutions and solution concentrations are applied in products and processes, in scientific studies and in daily life; and comparing the ways in which concentrations of solutions are expressed in the chemistry laboratory, in household products and in environmental studies
• using a balance and volumetric glassware to prepare solutions of specified concentration	OR
• performing an experiment to determine the identity of an ion, using simple qualitative tests, including solution colour, flame tests and solubility	• explaining the role of concentration in risk/benefit analysis and the significance of biological magnification in increasing the concentration of substances within ecosystems in terms of protecting the environment from harm to ensure quality of life for future generations
• writing dissociation/ionization equations for dissolved strong acids and ionic compounds	OR
• calculating, from empirical data, the concentration of solutions in moles per litre of solution and determining mass or volume from such concentrations	• evaluating the risk involved in safe handling, storing and disposing of solutions in common use in the laboratory and in the home
• calculating, from empirical data, the concentration of diluted solutions, and the quantities of a solution and water to use when diluting	OR
• using empirical data and dissociation equations to calculate the concentration of ions in a solution.	• investigating the application of the scientific principles of qualitative analysis in the practice of chemistry; e.g., careers in forensic science
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Acids and bases have an effect on aqueous *systems*.	• acids and bases affect the chemistry of aqueous systems, by extending from Science 9, Unit 5, and Science 10, Unit 3, the properties, formulas and names of acids and bases, and by: • defining acids and bases, ionization and neutralization, empirically and theoretically, based on Arrhenius' concepts • defining pH in terms of whole number powers of 10 • describing the relationship between pH and hydrogen ion concentration; i.e., a change of 1 in the pH value is equivalent to a ten-fold change in the hydrogen ion concentration • calculating whole number pH values from hydrogen ion concentration, and hydrogen ion concentration from whole number pH values.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that acids and bases affect the chemistry of aqueous systems by defining acids and bases, by differentiating among acidic, basic and neutral solutions, using simple tests, writing ionization equations, and calculating the concentrations of hydrogen and hydroxide ions in solution and pH, within the context of:
• using indicators, pH and conductivity to perform experiments to differentiate among acidic, basic and neutral solutions • calculating concentrations of H^+ or OH^- for strong acids and bases • constructing a table comparing pH and hydrogen ion concentration in order to illustrate that as the hydrogen ion concentration increases, the pH decreases.	• providing examples of processes and products that use knowledge of acid and base chemistry; e.g., pulp and paper, car batteries, food preparation, cleaning aids OR • identifying some everyday processes and products that require knowledge of how to handle acids and bases; e.g., sulfuric acid in car batteries, never mixing bleach with household cleaners; treating accidental acid or base spills, using neutralization and dilution OR • assessing, qualitatively, the risks and benefits of transporting acidic and caustic substances in populated areas in terms of the need to protect the environment to ensure society's safety and quality of life for future generations OR • relating the concept of pH to its application in describing solutions encountered in everyday life and comparing the pH scale to others, like the Richter scale for measuring the intensity of earthquakes OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. A model of the gaseous state of *matter* provides insight into molecular behaviour.	• the behaviour of gases has been extensively described, and relationships quantified, by extending from Science 7, Unit 4, the concept of temperature and from Science 10, Unit 4, the kinetic molecular theory and how it accounts for the properties of solids, liquids and gases, and by:
	• performing calculations, using Boyle's and Charles' laws, and illustrating how they are related to the combined gas law
	• relating Boyle's, Charles' and Avogadro's laws to the ideal gas law
	• converting between the Celsius and Kelvin temperature scales and expressing atmospheric pressure in a variety of ways; e.g., mm of Hg, atm, kPa
	• performing calculations based on the ideal gas equation, $PV=nRT$, under a variety of conditions; e.g., standard temperature and pressure (STP), standard ambient temperature and pressure (SATP)
	• describing the behaviour of real and ideal gases, in terms of the kinetic molecular theory.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the behaviour of gases by relating the gas laws proposed by Boyle, Charles and Avogadro to the ideal gas law, describing the behaviour of real and ideal gases in terms of the kinetic molecular theory; and by drawing and interpreting graphs that relate pressure and temperature to gas volume; designing, performing and evaluating experiments to illustrate the gas laws, and carrying out calculations based on the gas laws, within the context of:
• drawing and interpreting graphs of experimental data that relate pressure and temperature to gas volume • designing and performing an experiment to illustrate the gas laws, which identify and control variables • performing and evaluating an experiment to determine molar mass from gaseous volume • using empirical data to do calculations based on the ideal gas law.	• providing examples of processes and products from daily life that illustrate the application of the properties of gases; e.g., breathing, olfaction, weather, scuba diving, ammonia fertilizer, internal combustion engine, steam turbine, hot air balloon, automobile air bag OR • describing, from a historical perspective, the central role of experimentation, and the development of technologies capable of precise measurement in the formulation of the gas laws OR • evaluating, in terms of the influence of the needs, interests and financial support of society on scientific and technological research, the advantages and disadvantages of using compressed gases as fuels; e.g., hydrogen, methane, propane OR • any other relevant context.

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UNIT 2
QUANTITATIVE RELATIONSHIPS IN CHEMICAL CHANGES

OVERVIEW

Science Themes: *Change* and *Systems*

In Unit 2, students focus on chemical *change* and the quantitative relationships contained in the balanced chemical equation. Students are required to use mathematical manipulation and stoichiometric principles to predict quantities of substances consumed or produced in chemical reaction *systems*. This unit builds on Science 10, Unit 3: Energy and Matter in Chemical Change; and Chemistry 20, Unit 1: Matter as Solutions, Acids, Bases and Gases.

This unit provides students with a foundation for the study of quantitative relationships in thermochemical, electrochemical, and acid and base reactions in Chemistry 30.

The two **major concepts** developed in this unit are:

- balanced chemical equations indicate the quantitative relationships among reactants and products involved in chemical *changes*
- the relationships between amounts of reactants and products in chemical *changes* are used in quantitative analysis.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data related to quantitative relationships in chemical *change*.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science.

ATTITUDES

Students will be encouraged to:

- develop a positive attitude toward mathematical and scientific process skills
- appreciate the importance of careful laboratory techniques and precise calculations for obtaining accurate results
- develop confidence in their ability to reason mathematically
- value the role of technology, such as calculators and balances, in problem solving
- develop an awareness of the relationship between chemical principles and applications of chemistry
- appreciate the need for empirical evidence when interpreting observed phenomena.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Balanced chemical equations indicate the quantitative relationships among reactants and products involved in chemical *changes*.	• the mole ratios in balanced chemical reaction equations provide quantitative information about the substances involved, by extending from Science 10, Unit 3, the balancing of equations and the meaning of molar mass, and from Chemistry 20, Unit 1, the properties of solutions and gases, and by: • predicting the product(s) of a chemical reaction, based upon the reaction type • analyzing chemical equations in terms of atoms, molecules, ionic species and moles • identifying spectator ions in reactions taking place in aqueous solution • using gravimetric, solutions and gas stoichiometry to predict quantities of reactants/products involved in chemical reactions • using estimation and unit analysis in stoichiometric calculations • explaining stoichiometric calculations, using chemical principles.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that balanced chemical equations indicate quantitative relationships between reactants and products by analyzing chemical equations, performing and explaining stoichiometric predictions; and by performing experiments to test the assumptions contained in stoichiometric methods, within the context of:
• writing and balancing net ionic chemical equations to represent reactions taking place in aqueous solution	• analyzing, using stoichiometric and chemical principles, the chemical reactions involved in various industrial and commercial processes and products; e.g., fertilizers, production of sodium and chlorine in the Downs cell, Haber–Bosch production of ammonia, combustion of fuels, water treatment, inflation of automobile air bags
• performing experiments to test the validity of assumptions contained in stoichiometric methods, by, for example, predicting reaction results, then measuring the amount of product obtained from a reaction, and calculating the per cent yield.	OR
	• discussing the central role of experimental evidence and the way in which scientific theories may be supported, modified or refuted by, for example, citing Lavoisier's role in disputing the caloric theory
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The relationships between amounts of reactants and products in chemical *changes* are used in quantitative analysis.	• stoichiometric methods are important in quantitative analysis, by extending from Chemistry 20, Unit 1, solution concentrations, and by: • differentiating between quantitative and qualitative analysis • using evidence from titration to determine the concentration of a solution • using evidence from precipitation reactions to determine the concentration of ions in solutions, using gravimetric procedures • identifying limiting species in chemical reactions, and calculating predicted and experimental yields • explaining quantitative analysis, using chemical principles; e.g., conservation of mass in a chemical change.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the relationships among amounts of reactants and products in chemical changes, limiting species, predicted and experimental yields; and by designing, performing and evaluating experiments and carrying out calculations, based on quantitative analysis, to determine the concentration of a solution, within the context of:
• using appropriate glassware and equipment to perform a titration experiment to determine the concentration of a solution	• explaining the interrelationship of science and technology, using examples of how stoichiometry is applied; e.g., industries use stoichiometric calculations to determine the amount of raw materials needed to produce products with a minimum of waste
	OR
• performing and evaluating an experiment, based on a precipitation reaction, to determine the concentration of a solution	• describing industrial, commercial and household processes and products, and associated careers, that require a knowledge of quantitative analysis
	OR
• designing, performing and evaluating an experiment based on such methods as crystallization, filtration or titration, to determine the concentration of a solution.	• evaluating the significance of specific by-products from industrial, commercial and household applications of chemical reactions in terms of using technology to improve per cent yield, decrease waste and reduce environmental impact; e.g., recovering $SO_2(g)$ from smokestacks, installing catalytic afterburners on cars, finding alternatives to chlorine for disinfecting and bleaching
	OR
	• any other relevant context.

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UNIT 3
CHEMICAL BONDING IN MATTER

OVERVIEW

Science Theme: *Matter*

The major focus of this unit is to relate theories about bonding to the properties of *matter* and to develop explanations and descriptions of structure and bonding through scientific models.

This unit builds on Science 10, Unit 3: Energy and Matter in Chemical Change. This unit provides an introduction to Chemistry 30, Unit 1: Thermochemical Changes, and Unit 2: Electrochemical Changes.

The **major concept** developed in this unit is:

- chemical bonding in *matter* results in the formation of compounds.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- analyzing
- connecting, synthesizing and integrating while investigating bonding in *matter*.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of products or processes based on scientific principles
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research.

ATTITUDES

Students will be encouraged to:

- develop curiosity about the nature of chemical bonding
- appreciate the usefulness of models and theories in helping to explain the structure and behaviour of *matter*
- value the need for safe handling, storing and disposing of chemicals and materials
- tolerate the uncertainty in explanations about the nature of *matter*
- appreciate the restricted nature of evidence when interpreting observed phenomena.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Chemical bonding in *matter* results in the formation of compounds.	• theories about bonding propose that chemical bonds involve electron transfer or sharing, by extending from Science 10, Unit 3, the simple model of the atom, the organization of the periodic table and the differences in properties of ionic and covalent compounds, and by:
	• defining a chemical bond as resulting from the simultaneous attraction of electrons by two atomic nuclei
	• describing bonding as a continuum ranging from complete electron transfer to equal sharing of electrons
	• defining valence electron, electronegativity, electron pairing, ionic bond and covalent bond
	• determining the polarity of a molecule based on simple structural shapes and unequal charge distribution
	• explaining why formulas for ionic compounds refer to the simplest whole number ratio of ions that result in a net charge of zero, while the formulas for molecular compounds refer to the number of atoms of each constituent element
	• comparing intermolecular forces with intramolecular bonding, in terms of strength and species involved
	• explaining, in simple qualitative terms, the energy changes of bond breaking and bond formation and relating this to why some changes are exothermic while others are endothermic
	• describing the information contained in the activity series and how it was developed
	• defining oxidation as a loss of electrons and reduction as a gain of electrons
	• relating the terms oxidation and reduction to bonds forming between metals and nonmetals; e.g., corrosion.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
• building models depicting the structure of ionic solids and simple covalent molecules • using the periodic table as a tool for predicting the formation of ionic and molecular compounds • writing half-reactions for the formation of simple ionic compounds, showing oxidation of metals and reduction of nonmetals; then balancing for charge and combining into a single equation; e.g., $2Na_{(s)} \rightarrow 2Na^{+} + 2e^{-}$ $Cl_{2(g)} + 2e^{-} \rightarrow 2Cl^{-}$ $2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$ • designing and performing an experiment to investigate the reactivity of various metals with water, oxygen and dilute acids, to develop an activity series • using data contained in the periodic table and the activity series to predict bonding and electron transfer between elements • drawing electron dot diagrams of atoms and molecules, writing structural formulas for compounds, and using Lewis structures to predict bonding in simple molecules.	• understanding that chemical bonds involve electron transfer or sharing, by comparing and contrasting intermolecular and intramolecular bonding; building models of compounds, using the periodic table and activity series to predict bonding; designing and performing an experiment to investigate the activity series of metals, and drawing electron dot diagrams and Lewis structures, within the context of: • analyzing the functioning of everyday processes and products in which ionic and covalent compounds are significant; for example, investigating the composition of household products, combustion reactions and life processes OR • relating the chemical principles embedded in bonding theories, oxidation and reduction, and the activity series to terms such as "precious" metal, rusting, stability and reactivity OR • outlining the limitations of bonding theories, by; for example, investigating bonding in metals and ceramics, and investigating the concept of resonance OR • describing the central role of experimental evidence in the accumulation of knowledge, by relating the properties; e.g., melting and boiling points, solubility, density and viscosity, of common substances to their predicted intermolecular and intramolecular bonding OR • interrelating the applications and properties of such modern materials as semiconductors, ceramics and composites, explaining how science and technology interact in the production and distribution of useful materials; and explaining the influence of the needs, interests and financial support of society on scientific and technological research OR • any other relevant context.

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UNIT 4
THE DIVERSITY OF MATTER: AN INTRODUCTION TO ORGANIC CHEMISTRY

OVERVIEW

Science Themes: *Change, Diversity* and *Matter*

In this unit, students learn more about the *diversity* of *matter* from specific examples of organic compounds. They are introduced to the chemical and physical properties of organic compounds, the general nomenclature and formulas for hydrocarbon categories, their significant derivatives and reactions. Another theme of the unit is *change* as it relates to chemical reactions involving organic compounds in living and nonliving systems.

This unit builds on Science 9, Unit 5: Chemical Properties and Changes; Science 10, Unit 3: Energy and Matter in Chemical Change; and Chemistry 20, Unit 3: Chemical Bonding in Matter. The unit prepares students for the integrated approach to organic and inorganic chemistry that is taken in Chemistry 30.

The two **major concepts** developed in this unit are:

- organic compounds are a common form of *matter*
- the chemical *changes* of organic compounds are many and *diverse*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- organizing and communicating
- connecting, synthesizing and integrating in the investigation of organic compounds and their reactions.

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- develop an appreciation of the *diversity* of organic compounds and their significance to daily life
- appreciate that science and technology provide many useful products
- value the need for safe handling, storing and disposing of chemicals and materials
- develop an awareness that, as a result of chemistry, synthetic compounds of great benefit to society have been produced
- develop an awareness of the need for open-mindedness in evaluating environmental issues
- respect the contributions and limitations of scientific and technological knowledge to societal decision making.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Organic compounds are a common form of *matter*.	• organic compounds have distinguishing characteristics, by extending from Chemistry 20, Unit 3, ionic covalent bonding, and by:
	• comparing organic and inorganic compounds in terms of the presence of carbon, bonding and related properties, and natural sources
	• describing the composition and structural formulas for aliphatic (including cyclic) and aromatic hydrocarbons
	• providing names and formulas for examples of the organic compounds described above
	• defining and giving examples of structural isomerism
	• identifying alcohols, aldehydes, ketones, carboxylic acids, halogenated hydrocarbons, amines, amides and esters from their IUPAC names and the functional groups in their structural formulas.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that organic compounds have distinguishing characteristics by comparing them with inorganic compounds; describing the composition of and providing names and structural formulas for various hydrocarbons and their derivatives; and by investigating the physical and chemical properties of representative examples of organic compounds and building models depicting the structures of simple examples, within the context of:
• using safe substances and procedures to perform an experiment to investigate the physical and chemical properties of representative examples of organic compounds • gathering data to compare the properties of a pair of organic isomers • building molecular models depicting the structures of simple organic compounds.	• comparing examples of organic and inorganic compounds, where they are found and how they are used in processes and products common to everyday life OR • explaining different conventions of nomenclature in a historical and cultural context OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The chemical *changes* of organic compounds are many and *diverse*.	• organic compounds undergo a variety of chemical reactions, by extending from Science 9, Unit 5 and Science 10, Unit 3, chemical change, and by: • defining and giving examples of addition, substitution, elimination, esterification and combustion reactions of hydrocarbons • writing and balancing chemical equations for the reactions described above • defining, outlining structures, and providing examples of monomers, polymers and polymerization in living and nonliving systems; e.g., proteins, carbohydrates, plastics • comparing reactions of organic compounds in living and nonliving systems; e.g., the oxidation of carbohydrates and the combustion of fuels • comparing hydrocarbon cracking and reforming.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that organic compounds undergo a variety of chemical changes by defining, giving examples of and writing chemical equations for various reactions; and by synthesizing an organic compound in the laboratory and building models to depict polymerization, within the context of:
• building models depicting polymerization • synthesizing an organic compound; e.g., an alcohol, an ester, a polymer, a soap.	• analyzing common polymers in terms of chemical composition and structure; e.g., paper, plastics, fibres, foods, found in the home, school and community OR • describing the petrochemical industry in Alberta and investigating career opportunities related to organic chemistry OR • assessing the positive and negative effects of synthetically produced organic compounds, recognizing that the development of these products has played a major role in quality of life and standard of living but that a practical solution to related social and environmental problems often requires a compromise between competing priorities OR • any other relevant context.

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CHEMISTRY 30

UNIT 1
THERMOCHEMICAL CHANGES

OVERVIEW

Science Themes: *Change, Energy* and *Systems*

In this unit, students study *energy* as it relates to physical, chemical and nuclear *changes* and quantify the energy involved in thermochemical *systems*.

This unit builds on Science 9, Unit 3: Heat Energy: Transfer and Conservation; Science 10, Unit 1: Energy from the Sun, Unit 3: Energy and Matter in Chemical Change, Unit 4: Change and Energy; and Chemistry 20, Unit 2: Quantitative Relationships in Chemical Changes, and Unit 3: Chemical Bonding in Matter. This unit prepares students for post-secondary studies in related areas.

The **major concept** developed in this unit is:

- there are *energy changes* associated with *changes* to *matter*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing
- connecting, synthesizing and integrating
- evaluating the process or outcomes of investigations of *energy changes*.

The **STS connections** in this unit illustrate:

- the use of technology to solve practical problems
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- develop an interest in the *energy* transformations happening around them
- appreciate the usefulness of computational competence and problem-solving skills as they relate to *energy*
- value the need for accuracy and precision in data collection related to *energy*
- develop a sense of responsibility toward the use of *energy*
- develop an interest in global *energy* issues and the effectiveness of local activities in contributing to the solution of problems related to *energy*
- appreciate the need to balance long-term *energy* and environmental objectives with various societal needs
- appreciate the significance and meaning of various solutions to a problem.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. There are *energy changes* associated with *changes* to *matter*.	• energy changes can be measured and quantified, by extending from Science 9, Unit 3, the concepts of heat and temperature and Science 10, Unit 1 and Unit 4, the law of conservation of energy, the laws of thermodynamics, definitions for kinetic and potential energy, heat of fusion and calculations involving temperature and phase changes in water, based on $q=mc\Delta t$, as well as extending from Chemistry 20, Unit 3, the meaning of bond dissociation energy, exothermic and endothermic change, and by: • explaining what is meant by the energy change of a system in terms of heating and cooling, thermal equilibrium, temperature change, phase change, forces between particles, particle movement and heat content • writing balanced reaction equations that include the energy change • using and interpreting change in enthalpy (ΔH) notation for communicating energy changes • explaining that catalysts provide an alternative pathway for chemical changes without affecting the net amount of energy produced or absorbed • defining molar enthalpy/change, including the heats of phase, chemical and nuclear change • using Hess's law to derive equations for energy changes • using a standard heats of formation table to predict heat of reaction for a chemical change • explaining how energy stored as potential energy in the chemical bonds of fossil fuels originates in the Sun and is converted by the process of photosynthesis in living plants, represented simply as: $6CO_{2(g)}+6H_2O_{(l)} \rightarrow C_6H_{12}O_{6(s)}+6O_{2(g)}$ • comparing the combustion of fuels to cellular respiration, represented by the simple equation: $C_6H_{12}O_{6(s)}+6O_{2(g)} \rightarrow 6CO_{2(g)}+6H_2O_{(l)}$ • comparing phase, chemical and nuclear changes in terms of the magnitudes of the energy involved • providing simple, qualitative explanations based on intermolecular forces, chemical bonds and nuclear forces for the energy changes that occur during phase, chemical and nuclear changes to matter • recognizing nuclear fission and fusion reactions.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the energy changes associated with changes to matter can be measured and quantified by explaining the energy change of a system; providing simple, qualitative explanations for energy changes in phase, chemical and nuclear changes; performing calculations related to physical and chemical changes to matter; and by drawing and interpreting energy diagrams; and designing, performing and evaluating experiments to determine molar enthalpies and energy efficiency, within the context of:
• drawing and interpreting energy diagrams based on experimental data; e.g., heating curves and potential energy graphs for phase, chemical and nuclear changes • performing and evaluating experiments to determine the molar enthalpy change of physical and chemical changes to matter • performing calculations based on empirical data gathered from experiments demonstrating energy changes associated with physical and chemical changes to matter • designing an experimental procedure to compare the molar enthalpy change of burning two or more fuels • designing and constructing a heating device, and calculating its efficiency.	• providing examples of personal reliance on the chemical potential energy of matter; e.g., of fuels and identifying and evaluating ways of using energy more efficiently in the home and community in order to use natural resources judiciously to ensure adequate supplies for future generations OR • providing examples of how catalysts play a role in many important chemical and biochemical processes; e.g., enzymes in cell processes, catalysts in reducing air pollution OR • illustrating the economic importance of fossil fuels, with examples from the petroleum and petrochemical industries in Alberta; analyzing, using chemical principles, the refining of hydrocarbons; and investigating careers related to the energy industry OR • evaluating different fuels from the perspective of economic and environmental impact; and researching and analyzing alternative energy sources, in terms of the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations OR • assessing, qualitatively, the risks and benefits of relying on fossil fuels or nuclear reactions as energy sources, considering the limitations of scientific knowledge and technology in societal decision making OR • any other relevant context.

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UNIT 2
ELECTROCHEMICAL CHANGES

OVERVIEW

Science Themes: *Change, Energy, Matter* and *Systems*

In this unit, students study electrochemical *changes,* analyzing the *matter* and *energy changes* within a *system.*

This unit builds on Science 9, Unit 4: Electromagnetic Systems; Science 10, Unit 3: Energy and Matter in Chemical Change; Chemistry 20, Unit 2: Quantitative Relationships in Chemical Changes, and Unit 3: Chemical Bonding in Matter. This unit prepares students for post-secondary studies in related areas.

The two **major concepts** developed in this unit are:

- many chemical *changes* involve the transfer of electrons
- *energy* is involved in electrochemical *changes.*

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing
- connecting, synthesizing and integrating
- evaluating the process or outcomes of investigations of electrochemical *change.*

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- develop an interest in oxidation–reduction reactions that occur in everyday life
- appreciate the creativity and perseverance required to develop workable solutions to problems
- develop a willingness to try various problem-solving strategies, and risk being wrong
- value the contributions of the technological innovations of electrochemistry to quality of life
- develop an awareness that the application of technology by human societies can have beneficial and harmful effects on biological *systems*
- appreciate the multidimensional nature of science, technology and society issues.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Many chemical *changes* involve the transfer of electrons.	• oxidation–reduction reactions involve a transfer of electrons, by extending from Science 10, Unit 3, the structure of the atom and from Chemistry 20, Unit 3, the meanings for electronegativity, oxidation–reduction and the activity series, and by:
	• defining the terms: oxidizing agent, reducing agent, oxidation number, half-reaction, auto-oxidation (disproportionation)
	• differentiating between oxidation–reduction reactions and other reactions that do not involve oxidation–reduction by identifying half-reactions and changes in oxidation number
	• identifying electron transfer, oxidizing agents and reducing agents in oxidation–reduction reactions
	• writing and balancing equations for oxidation–reduction reactions: – using half-reaction equations obtained from a standard reduction potential table – developing simple half-reaction equations from information provided about oxidation–reduction changes – assigning oxidation numbers to the species undergoing chemical change
	• describing oxidation–reduction in simple biochemical processes; e.g., cellular respiration of glucose to carbon dioxide, $C_6H_{12}O_{6(s)}+6O_{2(g)}\rightarrow 6CO_{2(g)}+6H_2O_{(l)}$; photosynthesis in green plants, $6CO_{2(g)}+6H_2O_{(l)}\rightarrow C_6H_{12}O_{6(s)}+6O_{2(g)}$
	• comparing oxidation–reduction reactions in living and nonliving systems.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that many chemical changes involve a transfer of electrons by defining terms related to oxidation–reduction; identifying, writing and balancing equations for oxidation–reduction reactions, calculating unknown quantities from oxidation–reduction titration reactions; and by designing, performing and evaluating experiments for deriving a simple reduction table and testing predictions about oxidation–reduction, within the context of:
• comparing the relative strengths of oxidizing and reducing agents from empirical data • designing, performing then evaluating an experiment for deriving a simple reduction table • selecting and correctly using the appropriate equipment to perform an oxidation–reduction titration experiment • performing calculations to determine quantities of substances involved in oxidation–reduction reactions, by using data from titration experiments.	• analyzing, as an example of the functioning of products and processes based on scientific principles, oxidation–reduction reactions that occur in everyday life; e.g., corrosion, metallurgy, respiration, photosynthesis; identifying half-reactions, oxidizing and reducing agents OR • analyzing, as an example of the functioning of processes and products based on scientific principles, oxidation–reduction reactions used in industry and commercially; e.g., pulp and paper and textile bleaching, water treatment, food processing; identifying half-reactions, oxidizing and reducing agents OR • investigating the use of technology to solve practical problems related to corrosion OR • relating oxidation–reduction reactions to global environmental problems, such as the production of greenhouse gases and acid rain OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. *Energy* is involved in electrochemical *changes*.	• electrochemical (Voltaic) cells operate on the energy of spontaneous oxidation–reduction reactions, while electrolytic cells require electrical energy to cause nonspontaneous oxidation–reduction reactions to occur, by extending from Science 9, Unit 4, the design of a wet cell and from Chemistry 20, Unit 2, qualitative relationships in chemical changes, and by:
	• defining and identifying, on diagrams of electrochemical (Voltaic) and electrolytic cells, the following: anode, cathode, anion, cation; as well as salt bridge/porous cup and external circuit for the former and power supply for the latter
	• predicting and writing balanced equations for reactions at the anode and the cathode of electrochemical (Voltaic) and electrolytic cells recognizing that predictions and observations do not always concur; e.g., the production of chlorine gas from the electrolysis of brine
	• identifying, on diagrams of electrochemical (Voltaic) and electrolytic cells, the flow of electrons, the migration of anions and cations, mass and colour changes, formation of gases, and precipitates, at the electrodes
	• defining standard reduction potential and explaining how the values are all relative to $E^\circ = 0.00$ V set for the standard hydrogen electrode
	• calculating standard cell potential values for oxidation–reduction reactions
	• predicting the spontaneity or nonspontaneity of oxidation–reduction reactions on the basis of calculated standard cell potential values and relative positions of half-reaction equations on a standard reduction potential table
	• performing calculations to determine quantities of mass, volume, concentration, current and time in single electrochemical (Voltaic) and single electrolytic cells.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding electrochemical (Voltaic) and electrolytic cells by identifying and defining their important features on a diagram; predicting and writing balanced equations for reactions that occur at the anode and cathode, and performing calculations to determine quantities of products formed in them; and by designing, constructing, observing and describing electrochemical (Voltaic) and electrolytic cells, within the context of:
• constructing, observing and describing an electrolytic cell, comparing predictions and observations • designing, constructing and measuring the standard cell potential of an electrochemical (Voltaic) cell, comparing predictions and observations • evaluating experimental designs for electrochemical (Voltaic) and electrolytic cells, identifying limitations and suggesting improvements and alternatives • using a standard reduction potential table as a tool in predicting the spontaneity of oxidation–reduction reactions and their products • performing an experiment to test predictions about oxidation–reduction reactions with regard to spontaneity, products and standard cell potential values.	• analyzing the ways in which science advances technology and technology advances science in the applications of electrochemical (Voltaic) and electrolytic cells; e.g., batteries, electroplating industries, refining metals from their ores, and sanitizing swimming pools OR • comparing and contrasting the energy costs of refining metals from their ores with that of recycling metals, and outlining the process by which commonly used metal-based products; e.g., aluminum or "tin" cans, are recycled in the community as an example of society taking the responsibility to protect the environment and use natural resources judiciously to ensure quality of life for future generations OR • assessing the economic importance of batteries to modern society, predicting their future prominence; for example, in transportation; investigating the issue of disposing of used batteries, and proposing alternative solutions to this problem OR • any other relevant context.

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UNIT 3
EQUILIBRIUM, ACIDS AND BASES IN CHEMICAL CHANGES

OVERVIEW

Science Themes: *Change, Equilibrium* and *Systems*

In this unit, the concept that *change* eventually attains equilibrium is expanded to a quantitative treatment in reaction *systems* involving ideal gases and acid and base solutions. Students apply stoichiometric methods to titration experiments, further explore indicators and are introduced to buffer *systems*.

This unit builds on Science 8, Unit 1: Solutions and Substances; Science 9, Unit 5: Chemical Properties and Changes; Science 10, Unit 3: Energy and Matter in Chemical Change; Chemistry 20, Unit 1: Matter as Solutions, Acids, Bases and Gases, and Unit 2: Quantitative Relationships in Chemical Changes. This unit prepares students for post-secondary studies in related areas.

The three **major concepts** developed in this unit are:

- there is a balance of opposing reactions in chemical *equilibrium systems*
- acid and base *systems* are quantitatively and qualitatively described
- acid–base chemistry involves proton transfer.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing
- connecting, synthesizing and integrating
- evaluating the process or outcomes of investigations of *equilibrium*, acids and bases.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the limitations of scientific knowledge and technology
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate the usefulness of the mathematical model in describing chemical *equilibrium*
- value the role of precise observation and careful experimentation in learning about the chemistry of acids and bases
- tolerate the uncertainty involved in providing theoretical definitions for acids, bases and *equilibrium*
- value the need for safe handling, storing and disposing of chemicals and materials
- appreciate the complexity of environmental problems, such as acid deposition, that have no simple solution
- foster intellectual honesty, open-mindedness and objectivity when assessing environmental effects caused by chemical *change*.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. There is a balance of opposing reactions in chemical *equilibrium systems.*	• chemical reactions involving gases, acids and bases can be described as dynamic equilibrium systems, by extending from Chemistry 20, Unit 1, the model for equilibrium in a saturated solution, and by:
	• stating the criteria that apply to a system at equilibrium; e.g., closed system, constancy of properties, evidence of reversibility, equal rates of forward and reverse reactions
	• writing and interpreting chemical reaction equations for chemical systems at equilibrium
	• relating the reversibility of reactions in electrochemical cells to equilibrium
	• calculating equilibrium constants/concentrations for simple homogeneous chemical systems when: – concentrations at equilibrium are known – initial concentrations and one equilibrium concentration are known – the equilibrium constant and one equilibrium concentration are known
	• predicting if reactants or products are favoured in a reversible reaction, on the basis of the magnitude of the equilibrium constant
	• using Le Chatelier's principle to predict, qualitatively, shifts in equilibrium caused by changes in temperature, pressure, volume or concentration
	• explaining that catalysts do not affect the concentrations at equilibrium, only the time it takes for a system to reach equilibrium.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that many chemical reactions can be described as dynamic equilibrium systems by stating the criteria that identify them; writing equations, calculating equilibrium constants and concentrations for chemical systems at equilibrium, and by designing and performing experiments to analyze, qualitatively, shifts in equilibrium, within the context of:
• identifying variables and performing an experiment to test, qualitatively, predictions of equilibrium shifts.	• applying equilibrium principles to analyze everyday phenomena; e.g., the higher concentration of red blood cells in the circulatory systems of people living at high altitudes; carbon dioxide gas escaping from an open bottle of pop; the precipitation of limestone in caves; the rapid corrosion of metals in the presence of an acid; the role of oceans in the carbon cycle OR • analyzing industrial processes, such as the Haber–Bosch process for producing ammonia, and the Solvay process for making sodium carbonate, on the basis of equilibrium principles OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Acid and base *systems* are quantitatively and qualitatively described.	• acid and base systems are quantitatively and qualitatively described in a variety of ways, by extending from Science 8, Unit 1, Science 9, Unit 5 and Science 10, Unit 3, the properties of solutions, acids and bases, and from Chemistry 20, Unit 1, the definitions for acids, bases and pH, and by: • explaining the pH/pOH scale in terms of logarithms • defining K_w, K_a and K_b • calculating $H_3O^+_{(aq)}$ and $OH^-_{(aq)}$ concentrations, pH and pOH for solutions, using the ionization constant for water, K_w • predicting, qualitatively, changes in pH and pOH when a solution is diluted • differentiating between strength and concentration in acids and bases on the basis of empirical properties • comparing strong and weak acids and strong and weak bases, using equilibrium principles • performing calculations to determine any of pH, pOH, $[H_3O^+_{(aq)}]$, $[OH^-_{(aq)}]$, K_a, or K_b from the masses of solute, volumes and concentrations of solutions • performing calculations to determine masses of solutes, volumes or concentrations of solutions from pH, pOH, $[H_3O^+_{(aq)}]$, $[OH^-_{(aq)}]$, K_a and K_b.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that acid and base systems are quantitatively described, using pH, pOH, $[H_3O^+_{(aq)}]$, $[OH^-_{(aq)}]$, K_w, K_a, K_b, and concentration; and by performing calculations to determine any of the above from empirical data, and differentiating among strong and weak acids and bases and other solutions, within the context of:
• designing and performing an experiment to differentiate among strong and weak acids and bases and a variety of neutral solutions • calculating K_a and K_b from provided empirical data.	• describing the significance of pH in the formulation of various products, in the maintenance of viable aquatic and terrestrial environments, and in the body fluids of living systems; and understanding the importance of chemical principles to explain the functioning of products and processes OR • tracing, from a historical perspective, the development of the pH scale as an example of the way scientists have always strived to improve communication OR • explaining the significance of strength and concentration in chemical spills, in transport of dangerous goods, and in acid deposition; and discussing the need for society and individuals to protect the environment for future generations OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Acid–base chemistry involves proton transfer.	• Brønsted–Lowry acid–base reactions involve proton transfer, by extending from Chemistry 20, Unit 1, the Arrhenius definitions for acids and bases and neutralization, and from Chemistry 20, Unit 2, quantitative relationships in chemical changes, and by: • writing and interpreting chemical reaction equations illustrating the Brønsted–Lowry definition of acids and bases and neutralization • identifying conjugate pairs of Brønsted–Lowry acids and bases in chemical reaction equations • defining and describing indicators and explaining their colour changes in terms of an equilibrium shift • describing examples of substances that can act as either proton acceptors or proton donors (amphiprotic/amphoteric species) • describing examples of substances that can accept or donate more than one proton, and writing and interpreting related chemical equations • performing calculations related to quantitative reactions between acids and bases, including excess reagents in strong acid–strong base combinations • differentiating between indicator end point and equivalence point • explaining how buffers maintain a relatively constant pH when small amounts of acid, base or solvent are added to an aqueous system • providing examples of buffers that operate in living systems; e.g., in blood.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the Brønsted–Lowry definition of acids and bases by analyzing, predicting and writing chemical equations for acid and base reactions; explaining indicators, buffers and titration; performing calculations related to reactions between strong acids and strong bases; and by designing, performing and evaluating experiments to investigate acids, bases and buffer action; performing a titration experiment, and drawing and interpreting titration curve graphs, within the context of:
• predicting the most likely acid–base reaction, using tables of relative acid–base strength • designing and performing an experiment to determine the properties of organic and inorganic acids • standardizing an acid or base solution, using primary standards • performing a titration experiment and related calculations to determine the concentration of an acid or base solution • using a pH meter and laboratory glassware related to titrations • using indicators to determine the approximate pH of an acid or base solution • drawing and interpreting titration curve graphs, using data from titration experiments involving acids and bases in various combinations, including: – a strong acid with a strong base – a strong acid with a weak base – a weak acid with a strong base – a strong acid with a polybasic species – a strong base with a polyprotic species • designing, performing and evaluating an experiment to test buffer action.	• explaining, from a historical perspective, the limitations of acid–base concepts in explaining observed phenomena and the ways in which proposed theories for acids and bases have been supported, modified or refuted OR • explaining, using chemical principles, the formation of acid deposition, describing the environmental impact and the measures being taken by industries to reduce emissions, and evaluating the problem of acid deposition, recognizing that a practical solution is limited by current scientific knowledge and technology and may require a compromise between competing priorities OR • analyzing, on the basis of chemical principles, the application of acids, bases, indicators and buffers; e.g., in processing and storage of food, in pharmaceuticals, in cleaning aids, fertilizers and other industrial products OR • any other relevant context.

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PHYSICS 20–30

A. PROGRAM OVERVIEW

RATIONALE AND PHILOSOPHY

Physics is the study of matter and energy and their interactions. Through the study of physics, learners are given an opportunity to explore and understand the natural world and to become aware of the profound influence of physics in their lives. Learning is facilitated by relating the study of physics to what the learners already know, deem personally useful and consider relevant. Learning proceeds best when it originates from a base of concrete experiences presenting an authentic view of science in the context of physics. In Physics 20–30, students learn physics in relevant contexts and engage in meaningful activities. This facilitates the transfer of knowledge to new contexts. Students are encouraged to participate in lifelong learning about physics and to appreciate it as a scientific endeavour with practical impact on their own lives and on society as a whole.

Physics, as with all sciences, is an experimental discipline requiring creativity and imagination. Methods of inquiry characterize its study. In Physics 20–30, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop their critical thinking skills. Through experimentation, and problem-solving activities that include the integration of technology and independent study, students develop an understanding of the processes by which scientific knowledge evolves.

The Physics 20–30 program places students at the centre. Students are active learners and will assume increased responsibility for their learning as they work through the program. A thorough study of physics is required to give students an understanding that encourages them to make appropriate applications of scientific concepts to their daily lives and prepares them for future studies in physics. Students are expected to participate actively in their own learning. An emphasis on the key concepts and principles of physics provides students with a more unified view of the sciences and a greater awareness of the connections among them.

These science learnings will take varying amounts of time to acquire, depending on the individual learning styles and abilities of students. While each course is designed for approximately 125 hours, instructional time can be modified to meet the individual needs of students. Some students will require more than 125 hours, while others will require less.

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GOALS

The major goals of the Physics 20–30 program are:

- to develop in students an understanding of the interconnecting ideas and principles that transcend and unify the natural science disciplines

- to provide students with an enhanced understanding of the scientific world view, inquiry and enterprise

- to help students attain the level of scientific awareness essential for all citizens in a scientifically literate society

- to help students make informed decisions about further studies and careers in science

- to provide students with opportunities for acquiring knowledge, skills and attitudes that contribute to personal development.

Physics 20–30 is an academic program that helps students better understand and apply fundamental concepts and skills. The focus is on helping students understand the physics principles behind the natural events they experience and the technology they use in their daily lives. The program encourages enthusiasm for the scientific enterprise and develops positive attitudes about physics as an interesting human activity with personal meaning. It develops in students the knowledge, skills and attitudes to help them become capable of, and committed to, setting goals, making informed choices and acting in ways that will improve their own lives and life in their communities.

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B. LEARNER EXPECTATIONS

GENERAL LEARNER EXPECTATIONS

The general learner expectations outline the many facets of scientific awareness and serve as the foundation for the specific learner expectations covered in section C. The general learner expectations are developed in two categories: *program* expectations and *course* expectations.

PROGRAM GENERAL LEARNER EXPECTATIONS

The *program* general learner expectations are broad statements of science attitudes, knowledge, skills and science, technology and society (STS) connections that students are expected to achieve in all of the senior high school science programs. These *program* general learner expectations are further refined through the *course* general learner expectations and then developed in specific detail through the study of individual units in each of Physics 20 and Physics 30. All expectations follow a progression from Science 10 through to Physics 30, and though listed separately, are meant to be developed in conjunction with one another, within a context.

ATTITUDES

Students will be encouraged to develop:

- enthusiasm for, and a continuing interest in, science
- affective attributes of scientists at work; such as, respect for evidence, tolerance of uncertainty, intellectual honesty, creativity, perseverance, cooperation, curiosity and a desire to understand
- positive attitudes toward scientific and technological skills involving process skills, mathematics, and problem solving
- open-mindedness and respect for the points of view of others
- sensitivity to the living and nonliving environment
- appreciation of the roles of science and technology in our understanding of the natural world.

KNOWLEDGE

Science Themes

Students will be expected to demonstrate an understanding of themes that transcend the discipline boundaries, and show the unity among the natural sciences, including:

- Change: how all natural entities are modified over time, how the direction of change might be predicted and, in some instances, how change can be controlled
- Diversity: the array of living and nonliving forms of matter and the procedures used to understand, classify and distinguish those forms on the basis of recurring patterns
- Energy: the capacity for doing work that drives much of what takes place in the Universe through its variety of interconvertible forms
- Equilibrium: the state in which opposing forces or processes balance in a static or dynamic way
- Matter: the constituent parts, and the variety of states of the material in the physical world
- Systems: the interrelated groups of things or events that can be defined by their boundaries and, in some instances, by their inputs and outputs.

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SKILLS

Students will be expected to develop an ability to use thinking processes associated with the practice of science for understanding and exploring natural phenomena, problem solving and decision making. Students will also be expected to use teamwork, respect the points of view of others, make reasonable compromises, contribute ideas and effort, and lead when appropriate to achieve the best results. These processes involve many skills that are to be developed within the context of the program content.

Students will also be expected to be aware of the various technologies, including information technology, computer software and interfaces that can be used for collecting, organizing, analyzing and communicating data and information.

The skills framework presented here assumes that thinking processes often begin with an unresolved problem or issue, or an unanswered question. The problem, issue or question is usually defined and hypotheses formulated before information gathering can begin. At certain points in the process, the information needs to be organized and analyzed. Additional ideas may be generated—for example, by prediction or inference—and these new ideas, when incorporated into previous learning, can create a new knowledge structure. Eventually, an outcome, such as a solution, an answer or a decision is reached. Finally, criteria are established to judge ideas and information in order to assess both the problem-solving process and its outcomes.

The following skills are not intended to be developed sequentially or separately. Effective thinking is nonlinear and recursive. Students should be able to access skills and strategies flexibly; select and use skills, processes or technologies that are appropriate to the tasks; and monitor, modify or replace them with more effective strategies.

- Initiating and Planning
  - identify and clearly state the problem or issue to be investigated
  - differentiate between relevant and irrelevant data or information
  - assemble and record background information
  - identify all variables and controls
  - identify materials and apparatus required
  - formulate questions, hypotheses and/or predictions to guide research
  - design and/or describe a plan for research, or to solve a problem
  - prepare required observation charts or diagrams, and carry out preliminary calculations
- Collecting and Recording
  - carry out the procedure and modify, if necessary
  - organize and correctly use apparatus and materials to collect reliable data
  - observe, gather and record data or information accurately according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations
- Organizing and Communicating
  - organize and present data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
  - communicate data effectively, using mathematical and statistical calculations, where necessary
  - express measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
  - communicate findings of investigations in a clearly written report
- Analyzing
  - analyze data or information for trends, patterns, relationships, reliability and accuracy
  - identify and discuss sources of error and their affect on results

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- identify assumptions, attributes, biases, claims or reasons
- identify main ideas

- Connecting, Synthesizing and Integrating

  - predict from data or information, and determine whether or not these data verify or falsify the hypothesis and/or prediction
  - formulate further, testable hypotheses supported by the knowledge and understanding generated
  - identify further problems or issues to be investigated
  - identify alternative courses of action, experimental designs, and solutions to problems for consideration
  - propose and explain interpretations or conclusions
  - develop theoretical explanations
  - relate the data or information to laws, principles, models or theories identified in background information
  - propose solutions to a problem being investigated
  - summarize and communicate findings
  - decide on a course of action

- Evaluating the Process or Outcomes

  - establish criteria to judge data or information
  - consider consequences and biases, assumptions and perspectives
  - identify limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used
  - evaluate and suggest alternatives and consider improvements to the experimental technique and design, the decision-making or the problem-solving process
  - evaluate and assess ideas, information and alternatives

CONNECTIONS AMONG SCIENCE, TECHNOLOGY AND SOCIETY

Science, Technology and Society (STS)

Students will be expected to demonstrate an understanding of the processes by which scientific knowledge is developed, and of the interrelationships among science, technology and society, including:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of processes or products based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

FURTHER READING

For a more detailed discussion on how to integrate thinking and research skills into the science classroom, refer to the publications: *Teaching Thinking: Enhancing Learning,* 1990 and *Focus on Research: A Guide to Developing Students' Research Skills,* 1990.

For further reading on integrating science, technology and society into the classroom, refer to the publication: *STS Science Education: Unifying the Goals of Science Education,* 1990.

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COURSE GENERAL LEARNER EXPECTATIONS

The *course* general learner expectations are specific to each of Physics 20 and Physics 30 providing a bridge between the *program* general learner expectations and the specific learner expectations for each unit of study.

The attitudes expectations refer to those predispositions that are to be fostered in students. These expectations encompass attitudes toward science, the role of science and technology, and the contributions of science and technology toward society. The knowledge expectations are the major physics concepts in each course. The skills expectations refer to the thinking processes and abilities associated with the practice of science, including understanding and exploring natural phenomena, and problem solving. The connections among science, technology and society expectations focus on: the processes by which scientific knowledge is developed; the interrelationships among science, technology and society; and links each course to careers, everyday life and subsequent studies of physics.

Although itemized separately, the attitudes, knowledge, skills and STS connections are meant to be developed together within one or more contexts.

Physics 20–30

Attitudes

Students will be encouraged to:

- appreciate the role of empirical evidence and models in science, and accept the uncertainty in explanations and interpretations of observed phenomena
- value the curiosity, openness to new ideas, creativity, perseverance and cooperative hard work required of scientists, and strive to develop these same personal characteristics
- appreciate the role of science and technology in advancing our understanding of the natural world, be open-minded and respectful of other points of view when evaluating scientific information and its applications, and appreciate that the application of science and technology by humankind can have beneficial as well as harmful effects and can cause ethical dilemmas
- show a continuing interest in science, appreciate the need for computational competence, problem-solving and process skills when doing science, and value accuracy and honesty when communicating the results of problems and investigations
- appreciate the simplicity of, and similarity among, scientific explanations for complex, physical phenomena.

Physics 20

Students will be able to:

Knowledge

- compare and contrast scalar and vector quantities; and apply the concept of field to quantitatively explain, in terms of its source, direction and intensity, the gravitational effects of objects and systems
- describe, quantitatively, analyze and predict mechanical energy transformations, using the concepts of conservation of energy, work and power
- describe, quantitatively, analyze and predict motion with constant velocity, constant acceleration and uniform circular motion of objects and systems, using the concepts of kinematics, dynamics, Newton's laws of motion and the law of universal gravitation
- use the principles of simple harmonic motion and energy conservation to relate the concepts of uniform linear and circular motion to the behaviour and characteristics of mechanical waves

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- describe, quantitatively, analyze and predict the behaviour of light, using the concepts of geometric and wave optics, and graphical and mathematical techniques

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

- analyze and interpret data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and determine new variables, using the slopes of, and areas under graphs, plot corresponding graphs, and derive mathematical relationships among the variables

- use mathematical language of ratio and proportion, numerical and algebraic methods, two-dimensional vector addition in one plane, and unit analysis to solve single- and multi-step problems; and to communicate scientific relationships and concepts

Connections Among Science, Technology and Society

- apply cause and effect reasoning to formulate simple relationships for a given instance in which scientific evidence shapes or refutes a theory; and describe the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which physics and technology advance one another, using appropriate and relevant examples

- explain for a given instance how science and technology are influenced and supported by society, and the responsibility of society, through physics and technology, to protect the environment and use natural resources wisely

- identify subject-related careers and apply the knowledge and skills acquired in Physics 20 to everyday life and to related and new concepts in subsequent studies of physics.

Physics 30

Students will be able to:

Knowledge

- compare and contrast scalar and vector quantities and fields; and apply the concept of field to quantitatively explain, in terms of their source, direction and intensity, electric, gravitational and magnetic effects on objects and systems

- explain, quantitatively, analyze and predict physical interactions among objects and systems, using the concepts of conservation of energy and momentum

- describe, quantitatively, analyze and predict the behaviour of electric charges in electric and/or magnetic fields, using the principles of kinematics, dynamics, conservation of energy and electric charge, electrostatics and electromagnetism

- explain, quantitatively, analyze and predict the motor and generator effect involving a single conductor; and use relevant electromagnetic principles to explain the design and function of simple electric motors, generators, meters, transformers and other simple electromagnetic devices

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- illustrate, using biophysical, industrial and other examples, technological applications of electromagnetic theories and effects; and describe, quantitatively, analyze and predict the functioning of simple resistive direct current circuits, using Ohm's law and Kirchhoff's rules

- explain, quantitatively, the characteristics and behaviours of the various constituents of the electromagnetic spectrum, and algebraically solve problems, using the relationship among speed, wavelength and frequency of electromagnetic waves

- explain, citing empirical evidence, the development of an atomic theory contingent upon wave–particle duality of matter and statistical probability, and its technological application

Skills

- perform and evaluate investigations and tasks of their own and others' design that have multiple variables and yield direct or indirect evidence; and provide explanations and interpretations, using scientific theories and concepts

- collect, verify and organize data into tables, graphs and diagrams of their own design, using written and symbolic forms; and describe findings or relationships and make predictions, using scientific vocabulary, notation, theories and models

- analyze, interpret and evaluate data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and determine new variables using the slopes of, and areas under graphs, plot corresponding graphs, and use curve-straightening techniques to infer mathematical relationships among variables

- use mathematical language of ratio and proportion, numerical and algebraic methods, two-dimensional vector addition in one plane, unit analysis, and derived algebraic algorithms to solve multi-step, nonroutine problems; and communicate scientific relationships and concepts

Connections Among Science, Technology and Society

- apply cause and effect reasoning to formulate relationships for a range of instances in which scientific evidence shapes or refutes a theory; and explain the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples

- describe and evaluate the design and function of technological solutions to practical problems, using scientific principles or theories; and relate the ways in which physics and technology advance one another, using appropriate and relevant examples

- explain and evaluate for a given instance, and from a variety of given perspectives, how science and technology are influenced and supported by society; and assess the ability and responsibility of society, through physics and technology, to protect the environment and use natural resources wisely

- identify subject-related careers and apply the knowledge and skills acquired in Physics 30 to everyday life and to related and new concepts in post-secondary studies of physics.

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SPECIFIC LEARNER EXPECTATIONS

LEARNING CYCLE

The specific learner expectations consist of the knowledge, skills and attitudes that are to be addressed in Physics 20–30. The use of the learning cycle allows students to progress, from:

- an introduction framing the lesson in an STS connection relevant to the lives of the learners, and makes connections between past and present learning experiences, as well as anticipates activities to focus students' thinking on the learning outcomes of the activity

TO

- the experiential exploration of new content that provides students with a common base of experiences within which they identify and develop key concepts, processes and skills

THROUGH

- a hypothesis-building phase where concepts are developed to describe a particular aspect of their experiential exploration, and opportunities are provided to communicate their conceptual understanding, or demonstrate their skills or behaviours

TO

- an elaboration phase that extends understanding of key concepts and allows further opportunities to practise desired skills and problem-solving strategies

TO

- an application phase where the hypotheses, vocabulary and patterns previously developed are applied to new situations and related to key concepts and principles of science

TO

- a final evaluation of the significance of the new learning in an STS context to assess their understanding and abilities, and provide opportunities for evaluation of student progress toward achieving the curriculum standards.

In Physics 20–30, students examine phenomena in a variety of topics to show the relationships among all the sciences. Wherever possible, examples should be framed in the context of the learners' own experiences to enable them to make the connections between scientific knowledge and the society around them, the technology that societies have developed, and the nature of science itself.

PROGRAM OVERVIEW

The Physics 20–30 program emphasizes the science themes: *change, diversity, energy, equilibrium, matter* and *systems* as they relate to physics. These themes provide a means of showing the connections among the units of study in both courses of the program, and provide a framework for students to learn how individual sections of the program relate to the big ideas of science.

In addition to developing a solid understanding of fundamental science concepts and principles, Physics 20–30 has the goal of educating students about the nature of science and technology, and the interaction between physics and technology. Students must be aware of the tremendous impact of physics and associated technology on society, but at the same time, they must be aware of the roles and limitations of the physical sciences, science in general, and of technology in problem solving in a societal context.

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PHYSICS 20

Energy is the science theme common to all units in Physics 20, with *change, diversity, equilibrium, matter* and *systems* also playing a role. *Energy* in its many forms causes *change* and determines the kind of change *matter* and *systems* undergo.

The major concepts allow connections to be drawn among the four units of the course and among all eight units in the two courses in the program.

Physics 20 consists of four units of study:

Unit 1: Kinematics and Dynamics
Unit 2: Circular Motion and Gravitation
Unit 3: Mechanical Waves
Unit 4: Light.

An examination of motion, the causes of motion and their relationship to *energy changes* in *systems* emphasizes the science theme of *change* in Unit 1. In Unit 2, the principles of *change* in and conservation of *energy* motion are extended to circular motion, and lead into an investigation of gravitation and *equilibrium* in planetary *systems*. Unit 3 considers the transfer of *energy* through *matter* by means of mechanical waves, and the characteristics of waves are studied in the context of sound. Unit 4 focuses on the nature of light, a visible form of *energy* and one of the *diverse* forms of electromagnetic radiation.

PHYSICS 30

The *diversity* of *energy* and *matter* are the predominant themes of the Physics 30 course.

The major concepts allow connections to be drawn among the four units of the course and among all eight units in the two courses in the program.

Physics 30 consists of four units of study:

Unit 1: Conservation Laws
Unit 2: Electric Forces and Fields
Unit 3: Magnetic Forces and Fields
Unit 4: Nature of Matter.

Physics 30 expands upon the concepts and skills introduced in Science 10 and Physics 20. In Unit 1, students emphasize the science theme of *equilibrium*, as exemplified by the fundamental phenomenon of conservation of *energy* and momentum in isolated *systems* in the physical universe. In Unit 2, the electrical nature of *matter* in its *diverse* forms is examined. Unit 3 investigates the *diversity* and magnetic nature of *matter*, and electromagnetic interactions and technological applications. In Unit 4, the quantum concept of *energy* and *matter* is investigated via the study of the electric nature of the atom, the photoelectric effect and the wave–particle duality of radiation; as well, the applications of nuclear energy and the radioactive nature of the atom are studied.

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PHYSICS 20

UNIT 1
KINEMATICS AND DYNAMICS

OVERVIEW

Science Themes: *Change, Energy* and *Systems*

In Unit 1, students investigate *change* in position and velocity of objects and *systems* in a study of kinematics. The investigation of dynamic phenomena demonstrates that a *change* in *energy* is the manifestation of the effect of forces on the motion of objects and *systems*.

This unit extends the study of motion first introduced in Science 7, Unit 3: Force and Motion, and further developed in Science 10, Unit 4: Change and Energy, to a formal study of uniform motion, uniform accelerated motion, Newton's laws of motion, and concludes with a formal introduction to mechanical *energy*, work and power. This unit provides a foundation for further study of mechanics in subsequent units and physics courses.

The three **major concepts** developed in this unit are:

- *change* in the position and velocity of objects and *systems* can be described graphically and mathematically
- the concepts of dynamics explicitly relate forces to *change* in velocity
- work is a transfer of *energy*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from physical interactions
- connecting, synthesizing and integrating to relate the data to the laws and principles of kinematics and dynamics
- evaluating the process or outcomes of activities investigating the concepts of kinematics and dynamics.

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems.

ATTITUDES

Students will be encouraged to:

- appreciate the need for computational competence in quantifying motion, *energy*, work and power
- accept uncertainty in the descriptions and explanations of motion in the physical world
- be open-minded in evaluating potential applications of mechanical principles to new technology
- appreciate the fundamental role the principles of mechanics play in our everyday world
- appreciate the need for accurate and honest communication of all evidence gathered in the course of an investigation related to mechanical principles
- appreciate the need for empirical evidence in interpreting observed mechanical phenomena
- appreciate the restricted nature of evidence when interpreting the results of physical interactions.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. *Change* in the position and velocity of objects and *systems* can be described graphically and mathematically.	• the motion of objects and systems can be described in terms of displacement, time, velocity and acceleration, by extending from Science 10, Unit 4, the principles of one-dimensional motion, and by: • defining, operationally, and comparing and contrasting scalar and vector quantities • defining velocity as a change in position during a time interval • defining acceleration as a change in velocity during a time interval • comparing motion with constant velocity and variable velocity, and motion with constant acceleration and variable acceleration, average and instantaneous velocity • explaining uniform motion and uniformly accelerated motion, using position–time, velocity–time and acceleration–time graphs • applying the concepts of slope and area under a line or curve to determine velocity, displacement and acceleration from position–time and velocity–time graphs • explaining, quantitatively, two-dimensional motion, in horizontal or vertical planes, using vector components addition • explaining the uniform motion of objects, using algebraic and graphical methods, from verbal or written descriptions and mathematical data • explaining, quantitatively, the motion of one object relative to another object, using displacement and velocity vectors • using the delta notation correctly when describing change in quantities★ • using unit analysis to check the results of mathematical solutions.★

★ To be developed throughout the course.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the motion of objects and systems in terms of position, time, velocity and acceleration, and explaining uniform motion, using graphical, algorithmic and vector methods; and by gathering, and numerically and graphically analyzing relevant data to determine mathematical relationships among acceleration, displacement, velocity and time, within the context of:
• performing experiments to demonstrate the relationships among acceleration, displacement, velocity and time, using interval timers to gather the necessary data	• evaluating the design of structures and devices, such as roadway approaches and exit ramps, airport runways and carnival rides, in terms of kinematics principles
	OR
• inferring from a graphical analysis of empirical data the mathematical relationships among acceleration, displacement, velocity and time for uniformly accelerated motion	• analyzing the use of kinematics concepts in the synchronization of traffic lights
	OR
• analyzing empirical data graphically, using line-of-best-fit to discover mathematical relationships	• researching and reporting on the use of kinematics principles in traffic accident investigations
	OR
• performing experiments to determine the local value of the acceleration due to gravity.	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The concepts of dynamics explicitly relate forces to *change* in velocity.	• changes in velocity are the result of a non-zero net force, by recalling from Science 7, Unit 3, the notions of force, inertia and friction, and by:
	• comparing and contrasting among mass, volume and weight
	• explaining how a force effects a change in motion
	• applying Newton's first law of motion to explain an object's state of rest or uniform motion
	• applying Newton's second law of motion, and using it to relate force, mass and acceleration
	• relating Newton's third law of motion to interaction between two objects, recognizing that the two forces, equal in magnitude and opposite in direction, act on different bodies
	• determining, quantitatively, the net or resultant force acting on an object, using vector components addition graphically and mathematically
	• applying Newton's laws of motion to solve, algebraically, linear motion problems in horizontal, vertical and inclined planes, near the surface of Earth (whenever friction is included, only the resistive effect of the force of friction is considered)
	• solving projectile motion problems near the surface of Earth, ignoring air resistance.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding changes in velocity in terms of non-zero net forces, and applying Newton's laws of motion to explain, and quantitatively solve, linear motion problems; and by performing experiments to gather and mathematically analyze data relevant to dynamics problems, within the context of:
• performing experiments to determine the relationships among acceleration, force and mass, using interval timers to gather the necessary data	• explaining the movement of passengers in a vehicle changing speed and/or direction, in terms of the law of inertia OR
• using free-body diagrams in organizing and communicating the solutions of dynamics problems.	• assessing the design and use of injury prevention devices in cars and sports (business and industry) in terms of the principle of inertia and Newton's laws OR
	• evaluating the role of the principles of mechanics in solving practical problems and addressing societal needs when legal restrictions, such as seat belts and speed limits, are established OR
	• researching and reporting on the use of dynamics principles in traffic accident investigations OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Work is a transfer of *energy*.	• mechanical energy exchanges involve changes in kinetic and/or potential energy, by extending the mechanical energy concepts studied in Science 10, Unit 4, and by:
	• defining work as a measure of the mechanical energy transferred
	• defining, quantitatively, power as the rate of doing work
	• analyzing, quantitatively, mechanical energy transformations, using the law of conservation of mechanical energy.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding and quantitatively analyzing mechanical energy transformations, using the concept of conservation of mechanical energy; and by investigating and illustrating the relationships among mechanical energy, work and power, using empirical evidence and algorithms, within the context of:
• performing experiments investigating the relationships among mechanical energy, work and power • illustrating the relationships among mechanical energy, work and power, using empirical data and algorithms.	• evaluating the design of energy transfer devices, such as simple household tools, elevators, escalators and ski lifts, in terms of the relationships among mechanical energy, work and power OR • investigating and reporting on careers, supported by societal needs and interests, that require an understanding and application of kinematics and dynamics OR • any other relevant context.

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UNIT 2
CIRCULAR MOTION AND GRAVITATION

OVERVIEW

Science Themes: *Change, Energy, Equilibrium* and *Systems*

In Unit 2, students investigate *change* in motion and position of objects, and the dynamic *equilibrium* of planetary *systems,* in a study of circular motion and gravitation. Uniform circular motion is seen as an example of conservation of *energy*.

This unit extends the study of kinematics and dynamics from Unit 1 to uniform circular motion, an introduction to periodic motion. Two-dimensional vectors and Newton's laws are used to analyze and explain circular motion with uniform orbital speed. The concept of "field" is introduced to explain gravitational effects; and the role that the physical principles of circular motion had in the development of Newton's universal law of gravitation is examined. This unit provides a foundation for further study of mechanics and fields in subsequent units and physics courses.

The two **major concepts** developed in this unit are:

- Newton's laws of motion can be used to explain uniform circular motion
- gravitational effects extend throughout the Universe.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from physical interactions
- connecting, synthesizing and integrating to relate the data to the principles of uniform circular motion and gravitation
- evaluating the process or outcomes of activities investigating the concepts of circular motion and gravitation.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the influence of the needs, interests and financial support of society on scientific and technological research.

ATTITUDES

Students will be encouraged to:

- appreciate the need for computational competence in quantifying motion and gravitational effects
- accept uncertainty in the descriptions and explanations of circular motion and gravitation in the physical world
- be open-minded in evaluating potential applications of the principles of circular motion and gravitation to new technology
- appreciate the fundamental role the principles of circular motion have in explaining observed artificial and natural phenomena
- appreciate the fundamental role the principles of circular motion and gravitation play in our everyday world
- appreciate the contribution made by Kepler, Newton and Cavendish to the development of Newton's universal law of gravitation.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Newton's laws of motion can be used to explain uniform circular motion.	• uniform circular motion requires a non-zero net force of constant magnitude, by:
	• describing uniform circular motion as a special case of two-dimensional motion
	• describing forces in circular motion as gravitational, frictional, electrostatic
	• explaining, quantitatively, that the acceleration in circular motion is centripetal
	• explaining, quantitatively, circular motion in terms of Newton's laws of motion
	• solving, quantitatively, circular motion problems, using algebraic and/or graphical vector analysis
	• explaining, quantitatively, the relationships among speed, frequency, period and circular motion
	• analyzing, quantitatively, the motion of objects moving with constant speed in horizontal or vertical circles near the surface of Earth.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding uniform circular motion and its relationship to Newton's laws of motion, and explaining and solving, quantitatively, circular motion problems, using algebraic and/or graphical vector analysis; and by determining, empirically, the relationships among net force acting on an object moving in uniform circular motion, frequency, mass, speed and path radius, within the context of:
• performing experiments to determine the relationships among the net force, acting on an object in uniform circular motion, frequency, mass, speed and path radius.	• analyzing the principles of a centrifuge and its applications to solve problems in industry and research OR • analyzing the motion of a car, moving through a curve with constant speed, in terms of Newton's laws as applied to uniform circular motion, friction and road banking OR • analyzing, in terms of Newton's laws as applied to uniform circular motion, the motion of carnival rides and playground equipment moving in horizontal or vertical circles OR • analyzing, qualitatively, the function of a potter's wheel, in terms of Newton's laws as applied to uniform circular motion OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Gravitational effects extend throughout the Universe.	• gravity is a universal force of nature, by:
	• explaining, qualitatively, how mechanical understanding of circular motion and Kepler's laws were used in the development of Newton's universal law of gravitation
	• explaining, qualitatively, the principles pertinent to the Cavendish experiment used to determine the gravitational constant, G
	• relating the universal gravitational constant to the local value of the acceleration due to gravity
	• predicting, quantitatively, changes in weight that objects experience on different planets
	• defining "field" as a concept explaining action at a distance, and applying it to describing gravitational effects
	• applying, quantitatively, Newton's second law, combined with the universal law of gravitation, to explain planetary and satellite motion, using the circular motion approximation
	• predicting the mass of a planet from the orbital data of a satellite in uniform circular motion
	• explaining, qualitatively, the shape of our solar system, and that of galaxies, in terms of Newton's laws of motion and Newton's law of gravitation.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that gravity is a universal force of nature, and defining "field" as a concept explaining action at a distance and applying it to describing gravitational effects, and explaining, quantitatively, planetary and satellite motion, using Newton's second law combined with Newton's universal law of gravitation and the circular motion approximation, within the context of:
• relating the gravitational force, using Newton's second law, to planetary and satellite motion problems.	• discussing and evaluating the potential applications of "microgravity" conditions in research and manufacturing to advance scientific and technological knowledge, and the influence of the needs, interests and financial support of society on scientific and technological research OR • examining the functioning and applications of geosynchronous satellites to advance scientific and technological knowledge, and the influence of the needs, interests and financial support of society on scientific and technological research OR • explaining the mass distribution in our solar system and/or the Universe in terms of the chaos theory and gravitational attraction OR • assessing objectively, in terms of scientific principles and/or the needs, interests and financial support of society, the desirability of designing and building a space station, and evaluating the impact that living on a space station has on quality of life OR • any other relevant context.

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UNIT 3
MECHANICAL WAVES

OVERVIEW

Science Themes: *Energy* and *Matter*

In Unit 3, students investigate the transmission of *energy* through *matter* by means of mechanical waves.

This unit uses a brief introduction to simple harmonic motion as a bridge from circular periodic motion to linear oscillation. The concepts of motion and *energy* are extended to the study of mechanical wave characteristics and behaviour. Sound is used as an example of a mechanical wave and to enhance understanding of wave behaviour and characteristics. This unit serves as a link between Unit 1: Kinematics and Dynamics, and Unit 4: Light.

The two **major concepts** developed in this unit are:

- many vibrations are simple harmonic
- waves are a means of transmitting *energy*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from observations of mechanical wave phenomena
- connecting, synthesizing and integrating to predict mechanical wave behaviour, from data or information
- evaluating the process or outcomes of activities investigating the concepts of mechanical waves.

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate the need for computational competence in quantifying wave behaviour and characteristics
- accept uncertainty in the descriptions and explanations of wave phenomena in the physical world
- be open-minded in evaluating potential applications of mechanical wave principles to new technology
- appreciate the fundamental role the principles of mechanical waves have in explaining observed artificial and natural phenomena
- appreciate the fundamental role the principles of mechanical waves play in our everyday world.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Many vibrations are simple harmonic.	• simple harmonic motion is used to describe mechanical wave motion, by: • defining simple harmonic motion as motion toward a fixed point, with an acceleration, due to a restoring force, that is proportional to the displacement from the equilibrium position • explaining, qualitatively, the relationships among displacement, acceleration, velocity and time, for simple harmonic motion, in terms of uniform circular motion • explaining, quantitatively, the relationships among kinetic, potential and total mechanical energies of a mass executing simple harmonic motion • defining resonance, and giving examples of mechanical and/or acoustical resonance • describing wave motion in terms of the simple harmonic motion of particles.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that simple harmonic motion links uniform circular motion to the characteristics of mechanical waves, and explaining and solving, using mathematical methods, simple harmonic motion problems; and by relating, from empirical evidence, frequency and period of a simple harmonic motion to the physical characteristics of a system, within the context of:
• designing and performing an experiment to demonstrate that simple harmonic motion can be observed in objects within certain limits, and relate the frequency and period of the motion to physical characteristics of the system; e.g., a mass on a light, vertical spring or a simple pendulum	• analyzing, qualitatively, in terms of scientific principles, dampening forces in real-life examples of simple harmonic motion; e.g., springs in vehicle suspensions, pendulum clocks, metronomes OR
• observing the phenomenon of mechanical and acoustical resonance	• analyzing seismic waves and their impact on structures on Earth's surface OR
• predicting and verifying the conditions required for mechanical resonance to occur.	• assessing the implications of resonance in the design of structures and devices with moving parts; e.g., cars, bridges, buildings OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Waves are a means of transmitting *energy*.	• energy from simple harmonic motion can be transmitted as a wave through a medium, by:
	• describing medium particle vibrations as the source of mechanical waves
	• comparing and contrasting energy transmission by matter that moves and by waves that move
	• explaining the characteristics of waves in terms of the direction of vibration of the medium particles in relation to the direction of propagation of the disturbance
	• defining and using the terms wavelength, amplitude, transverse and longitudinal, in describing waves
	• explaining how a wave travels with a speed determined by the characteristics of the medium
	• relating the frequency of a wave to the period of the source, and the speed of propagation to the frequency and wavelength
	• predicting, quantitatively, and verifying, the effects of changing one, or a combination, of the variables in the relationship $v = f\lambda$
	• explaining the behaviour of waves at the boundaries between mediums; e.g., reflection and refraction at "open" and "closed" ends
	• predicting the resultant displacement when two waves interfere
	• explaining the Doppler effect on a stationary observer with a moving source, and a moving observer with a stationary source.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that mechanical waves are a means of transmitting energy through a medium, and describing and explaining wave characteristics and behaviour, such as reflection, refraction, interference, resonance and the Doppler effect, using appropriate terms; and by gathering and analyzing empirical evidence describing the characteristics and behaviour of mechanical waves, within the context of:
• determining the speed of a water wave in a ripple tank or a wave pulse travelling along a stretched spring, flexible coil or rope • observing the phenomena of reflection, refraction, diffraction and interference of mechanical waves • drawing a diagram of the resultant wave, when two waves interfere, using the principle of superposition • designing and performing experiments to measure the speed of sound in air, using resonance in an air column that is closed at one end • identifying the differences between sounds, such as loudness, pitch and quality.	• investigating the application of acoustical phenomena, and other wave characteristics and behaviour, to solve practical problems in recreational, medical, industrial and research technology, and the influence of the needs, interests and financial support of society on scientific and technological research; e.g., sonar, ultrasound, sonography, radar, pipe organs, wind and brass instruments OR • assessing the impact of noise and sound in daily life, and evaluating the design and functioning of noise reduction devices and their impact on the quality of life OR • investigating the requirements and potential of careers, supported by societal needs and interests, involving sound OR • any other relevant context.

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UNIT 4
LIGHT

OVERVIEW

Science Themes: *Diversity* and *Energy*

In Unit 4, students investigate *diversity* and *energy*, in a study of the nature and behaviour of light.

This unit applies prior knowledge from Unit 3 about the characteristics and behaviour of waves, in addition to the principles and methods of ray optics, to the phenomenon of light. The nature of science is particularly emphasized by the attention paid to the use of models in the development of a theory of light. This unit provides a foundation for the study of electromagnetic radiation and the photon model of light in Physics 30.

The two **major concepts** developed in this unit are:

- geometric optics is one model used to explain the nature and behaviour of light
- the wave model of light improves our understanding of the behaviour of light.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from observations of light phenomena, and identifying the limits of the data or information obtained
- connecting, synthesizing and integrating to relate the data to the behaviour and characteristics of light
- evaluating the process or outcomes of activities investigating the characteristics and behaviour of light.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the influence of the needs, interests and financial support of society on scientific and technological research.

ATTITUDES

Students will be encouraged to:

- appreciate that models are modified, as new and/or conflicting evidence is presented
- appreciate the need for computational competence in quantifying the behaviour of light
- accept uncertainty in the descriptions and explanations of the behaviour and nature of light
- be open-minded in evaluating potential applications of the principles of the nature of light to new technology
- appreciate the fundamental role of models in explaining observed natural phenomena
- appreciate the fundamental role the principles of the nature and behaviour of light play in our everyday world.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Geometric optics is one model used to explain the nature and behaviour of light.	• geometric optics can be used to explain observed phenomena of light, by:
	• citing evidence for the linear propagation of light
	• explaining a method of measuring the speed of light
	• calculating c, given experimental data of various methods employed to measure the speed of light
	• defining a ray as a straight line representing the rectilinear propagation of light
	• explaining, using ray diagrams, the phenomena of dispersion, reflection and refraction at plane and uniformly curved surfaces
	• stating and using Snell's law in the form of $n_1 \sin \theta_1 = n_2 \sin \theta_2$
	• deriving the curved mirror equation from empirical data
	• solving reflection and refraction problems, using algebraic, trigonometric and graphical methods
	• analyzing simple optical systems, consisting of no more than two lenses or one mirror and one lens, using algebraic and/or graphical methods.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding and explaining observed light phenomena, reflection, refraction and dispersion in terms of geometric optics, and solving reflection and refraction problems, using algebraic, trigonometric and graphical means; and by gathering and mathematically analyzing relevant data describing the characteristics and behaviour of light, within the context of:
• designing and performing an experiment demonstrating that light travels in a straight line when in a uniform medium • performing experiments demonstrating reflection and refraction at plane and uniformly curved surfaces • deriving the mathematical representations of the laws of reflection and refraction, from the data obtained from these experiments • performing an experiment to determine the index of refraction of several different substances, and predicting the conditions required for total internal reflection to occur.	• assessing the influence of available technology on the experimental designs used by Galileo, Römer, Huygens, Fizeau, Foucault, Michelson and contemporary experimenters, to measure the speed of light OR • assessing the processes in which light affects living organisms, and the use of light technology to solve practical problems; e.g., growth, vision OR • evaluating and explaining technological and biological applications of linear propagation, reflection, refraction and total internal reflection of light to solve practical problems, and how these applications reflect the needs, interests and financial support of society; e.g., binoculars, eyeglasses, design of greenhouses, solar collectors, fibre optics OR • investigating the requirements and potential of careers, supported by societal needs and interests, involving optics OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The wave model of light improves our understanding of the behaviour of light.	• wave optics can explain light phenomena that geometric optics cannot, by recalling from Unit 3, the behaviour of waves during reflection, refraction and interference, and by:
	• comparing the explanations of reflection and refraction by the particle theory and by the wave theory of light
	• explaining, using the wave theory of light, the phenomena of reflection and refraction
	• explaining why geometric optics fail to adequately account for the phenomena of diffraction, interference and polarization
	• explaining, qualitatively, diffraction and interference, using the wave model of light
	• explaining how the results of Young's double-slit experiment support the wave theory of light
	• solving double-slit problems, using $\lambda = \frac{xd}{nl}$, and diffraction grating problems, using $\lambda = \frac{d \sin \theta}{n}$
	• explaining, qualitatively, polarization in terms of the wave model of light
	• demonstrating how Snell's law in the form $\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$ offers support for the wave model of light.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding how the wave model explains the behaviour of light in the phenomena of interference, double-slit diffraction and polarization; and by empirically investigating and mathematically analyzing the phenomena of diffraction and interference, within the context of:
• predicting the conditions required for diffraction to be observed	• investigating and reporting on Newton's influence, and the role of experimental evidence, in the development of a model for the theory of light OR
• performing an experiment to determine the wavelength of a light source in air or a liquid, using a Young's double-slit apparatus or a diffraction grating	• identifying and explaining, qualitatively, Poisson's spot as an example of the role of experimental evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted where a model predicted new light phenomena OR
• predicting and performing an experiment to verify the effects on an interference pattern due to changes in any one or more of the following variables: wavelength, slit separation or screen distance.	• analyzing, qualitatively, the structure and function of polarizing filters in everyday life and nature, in terms of scientific principles; e.g., sunglasses, photography, bees, calculator liquid crystal diodes (LCDs) OR
	• any other relevant context.

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PHYSICS 30

UNIT 1
CONSERVATION LAWS

OVERVIEW

Science Themes: *Energy, Equilibrium* and *Systems*

In Unit 1, students investigate *energy* and *equilibrium* in the physical world, in a study of the conservation of *energy* and momentum.

In this unit, the *energy* concepts from Science 10, Unit 4: Change and Energy; and Physics 20, Unit 1: Kinematics and Dynamics, are recalled and extended. The vector nature of momentum is explored through the algebraic and graphical solution of conservation of linear momentum problems. The principles learned are reinforced by analyzing common and practical physical interactions in isolated *systems*. This unit provides a foundation for further study of mechanics in subsequent units and for post-secondary studies in physics.

The two **major concepts** developed in this unit are:

- conservation of *energy* in an isolated *system* is a fundamental physical concept
- momentum is conserved when objects interact in an isolated *system*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from physical interactions
- connecting, synthesizing and integrating to relate the data to the laws and principles of conservation of energy and momentum
- evaluating the process or outcomes of activities investigating the concepts of conservation of energy and momentum.

The **STS connections** in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems
- the influence of the needs, interests and financial support of society on scientific and technological research.

ATTITUDES

Students will be encouraged to:

- appreciate the need for computational competence in quantifying conservation of energy and momentum
- accept uncertainty in the descriptions and explanations of conservation in the physical world
- be open-minded in evaluating potential applications of conservation principles to new technology
- appreciate the fundamental role the principles of conservation play in our everyday world
- appreciate the need for simplicity in scientific explanations of complex physical interactions and the role conservation laws play in many of these explanations
- appreciate the need for accurate and honest communication of all evidence gathered in the course of an investigation related to conservation principles
- appreciate the need for empirical evidence in interpreting observed conservation phenomena
- appreciate the restricted nature of evidence when interpreting the results of physical interactions.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Conservation of *energy* in an isolated *system* is a fundamental physical concept.	• mechanical energy interactions involve changes in kinetic and potential energy, by extending energy concepts from Science 10, Unit 4, and the mechanical energy concepts and problem-solving methods studied in Physics 20, Unit 1, and by: • describing energy and mass as scalar quantities • relating the conservation of mass and energy in a qualitative analysis of Einstein's concept of mass–energy equivalence • defining mechanical energy as the sum of kinetic and potential energy • solving conservation problems, using algebraic and/or graphical analysis • analyzing and solving, quantitatively, kinematics and dynamics problems, using mechanical energy conservation concepts by extending previous problem-solving methods.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that changes in kinetic and potential energy occur in mechanical energy interactions; and analyzing and solving, quantitatively, kinematic and dynamics problems, using mechanical energy concepts, and algebraic and/or graphical analyses; and by gathering, and graphically analyzing, relevant data inferring mathematical relationships, within the context of:
• designing and performing experiments demonstrating the law of conservation of energy, and the relationship between kinetic and mechanical potential energy	• investigating and reporting the application of conservation principles in research and design OR
• using free-body diagrams (force diagrams) in organizing and communicating the solutions of conservation problems	• any other relevant context.
• analyzing data graphically, using curve-straightening techniques, to infer mathematical relationships.	

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Momentum is conserved when objects interact in an isolated *system.*	• conservation laws provide a simple means to explain interactions among objects, by:
	• describing momentum as a vector quantity
	• defining momentum as a quantity of motion equal to the product of the mass and the velocity of an object
	• relating Newton's laws of motion, quantitatively, to explain the concepts of impulse and a change in momentum
	• explaining, quantitatively, using vectors, that momentum appears to be conserved during one- and two-dimensional interactions in one plane among objects (the sine and cosine rules are not required)
	• defining, comparing and contrasting elastic and inelastic collisions, using quantitative examples
	• comparing scalar and vector conservation laws.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the law of conservation of momentum provides a means to explain interactions among objects; and explaining, quantitatively, using vectors and one- and two-dimensional interactions in one plane; and by obtaining and analyzing empirical evidence to demonstrate the conservation of momentum, and estimating and predicting results of interactions, within the context of:
• performing and analyzing experiments demonstrating the conservation of momentum and the principle of impulse • approximating, estimating and predicting results of interactions, based on an understanding of the conservation laws.	• assessing the role conservation laws and the principle of impulse play in the design and use of injury prevention devices in vehicles and sports; e.g., air bags, child restraint systems, running shoes, helmets OR • analyzing how the need for decreasing momentum over a long period has influenced the design of ropes used in such activities as "bunji" jumping and mountain climbing OR • investigating and reporting on a technology developed to improve the efficiency of energy transfer in a response to reconcile the energy needs of society with its responsibility to protect the environment and to use energy judiciously OR • investigating and reporting on a safety device that results in a cost saving to consumers and society, in terms of the problem addressed and its impact on quality of life OR • any other relevant context.

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UNIT 2
ELECTRIC FORCES AND FIELDS

OVERVIEW

Science Themes: *Diversity, Energy* and *Matter*

In Unit 2, the *diversity* of *matter* is highlighted as its electric nature is considered in the context of electrical interactions and electric energy.

This unit covers the principles of electrostatics and how to describe the interaction of electric charges mathematically from empirical data. The concepts from Physics 20, Unit 1: Kinematics and Dynamics, are extended to charged particle dynamics. The concept of field, introduced in Physics 20, Unit 2: Circular Motion and Gravitation, is applied to electrical phenomena. The unit concludes with the consideration of electric *energy* and simple direct current (DC) circuits. This unit provides a foundation for further study of electrical principles in subsequent units and for post-secondary studies in physics.

The four **major concepts** developed in this unit are:

- the laws governing electrical interactions are used to explain the behaviour of electric charges at rest
- Coulomb's law relates electric charge to electric force
- electric field theory is a model used to explain how charges interact
- electric circuits facilitate the use of electric *energy*.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from electrical interactions
- connecting, synthesizing and integrating to relate the data to the laws and principles of electric forces and fields
- evaluating the process or outcomes of activities investigating the concepts of electric forces and fields.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate the need for computational competence in quantifying electrical interactions
- accept uncertainty in the descriptions and explanations of electrical phenomena in the physical world
- be open-minded in evaluating potential applications of electrical principles to new technology
- appreciate the fundamental role the principles of electricity play in our everyday world
- appreciate the need to follow safe practices when working with electricity
- foster a responsible attitude to environmental and social change as related to the use and production of electrical *energy*
- appreciate the restricted nature of evidence when interpreting the results of electrical interactions.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. The laws governing electrical interactions are used to explain the behaviour of electric charges at rest.	• the electrical model of matter is fundamental to the explanation of electrical interactions, by extending from Physics 20, Unit 1, and by: • describing matter as containing discrete positive and negative particles • explaining electrical interactions in terms of the law of conservation of charge • explaining electrical interactions in terms of the law of electric charge (two types of charge: like charges repel, unlike charges attract) • comparing the methods of transferring charge: conduction and induction.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the electrical model of matter is fundamental to the explanation of electrical phenomena; and explaining electrical interactions in terms of the law of conservation of charge and the law of electric charge; and by investigating, empirically, and explaining electrostatics, using the electric nature of matter, within the context of:
• performing an activity demonstrating the electrical nature of matter, using methods of electrification, and describing observations in terms of the laws of electrostatics	• assessing how the principles of electrostatics are used to solve problems in industry and technology, and improve upon quality of life; e.g., telephones, photocopiers, electrostatic air cleaners, precipitators
	OR
• using safe practices when conducting electrical experiments.	• investigating natural and artificial electrical discharge and the need for grounding in terms of scientific principles and the inability of science to provide complete answers to all questions
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Coulomb's law relates electric charge to electric force.	• Coulomb's law explains the relationships among force, charge and separating distance, by:
	• explaining, qualitatively, the principles pertinent to Coulomb's torsion balance experiment
	• explaining, quantitatively, using Coulomb's law and vectors, the electrostatic interaction between discrete point charges
	• comparing the inverse square relationship as it is expressed by Coulomb's law and Newton's universal law of gravitation.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the relationships among force, charge and separating distance is explained by Coulomb's law; and explaining, quantitatively, using Coulomb's law and vectors, the electrostatic interaction between discrete point charges; and by gathering and analyzing relevant data inferring the mathematical relationships among force, charge and separating distance, within the context of:
• performing an experiment demonstrating the relationships among magnitude of charge, electric force and distance	• comparing and contrasting the experimental designs used by Coulomb and Cavendish, in terms of the role of technology in advancing science
• inferring the mathematical relationships among force, charge and separating distance from empirical evidence.	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Electric field theory is a model used to explain how charges interact.	• the concept of field is applied to electric interactions, by extending from Physics 20, Unit 2, the definition of field, and by:
	• comparing scalar and vector fields
	• comparing forces and fields
	• explaining, quantitatively, using vector addition, electric fields in terms of intensity (strength) and direction relative to the source of the field
	• explaining, quantitatively, using vector addition, electric fields in terms of intensity (strength) and direction relative to the effect on an electric charge
	• predicting, using algebraic and/or graphical methods, the path followed by a moving electric charge in a uniform electric field, using kinematics and dynamics concepts
	• explaining electrical interactions, quantitatively, using the conservation laws of energy and charge.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding the concept of field as related to electrical interactions; and explaining, quantitatively, using vector addition electric fields in terms of intensity and direction relative to the source of the field and its effect on an electric charge; and by plotting electric fields, using field lines and linking centripetal force to the electric force, within the context of:
• plotting electric fields, using field lines, for fields induced by discrete point charges, combinations of discrete point charges (like and oppositely charged) and charged parallel plates	• evaluating electric field theory as a model used to explain the behaviour of electric charges in terms of supporting experimental evidence
	OR
• relating the electric force, using Newton's second law, to the motion of an electric charge following a curved path in an electric field.	• explaining, qualitatively, how the problem of protecting sensitive components in a computer from electric fields is solved
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
4. Electric circuits facilitate the use of electric *energy*.	• Ohm's law and Kirchhoff's rules are fundamental to explaining simple electric circuits, by:
	• defining current, potential difference, resistance and power, using appropriate terminology
	• defining the ampere as a fundamental SI unit, and relating the coulomb and second to it
	• distinguishing between conventional and electron flow current
	• explaining Ohm's law as an empirical, rather than a theoretical, relationship
	• quantifying electrical energy and power dissipated in a resistor, using Ohm's law
	• explaining Kirchhoff's current and voltage rules as a logical consequence of the laws of conservation of energy and charge
	• analyzing, quantitatively, simple series and/or parallel DC circuits in terms of the variables of potential difference, current and resistance, using Kirchhoff's rules and/or Ohm's law (solutions requiring Kirchhoff's rules to be limited to networks containing two power supplies and three branch currents).

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding and analyzing, quantitatively, simple series and parallel circuits in terms of Ohm's law and Kirchhoff's rules; and quantifying electrical energy and power dissipated in a resistor, using Ohm's law; and by determining, from empirical and theoretical evidence the relationships among electric energy/power, current, resistance and voltage, within the context of:
• determining, from empirical and theoretical evidence, the relationships among electric energy/power, current, resistance and voltage • performing an experiment to explain the relationships among current, voltage and resistance • designing, analyzing and solving simple resistive DC circuits • drawing diagrams of simple resistive DC circuits, using accepted symbols for circuit components • designing and performing an experiment demonstrating the heating effect of electric energy.	• analyzing common technological applications of electricity to solve practical problems in daily life; e.g., toasters, hair dryers, light fixtures OR • comparing and contrasting electrical energy with other energy sources with respect to such factors as cost, energy potential, risks and benefits to society, safety concerns and their impact on the quality of life of future generations OR • analyzing the use of series and parallel networks in household circuits in terms of the problems addressed OR • investigating the need for and the functioning of circuit breakers in household circuits OR • analyzing the risks of electric shock in terms of scientific principles OR • investigating the requirements and potential of careers, supported by societal needs and interests, involving electricity OR • any other relevant context.

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UNIT 3
MAGNETIC FORCES AND FIELDS

OVERVIEW

Science Themes: *Diversity* and *Matter*

In Unit 3, the *diversity* of *matter* is highlighted as its magnetic nature is considered in the context of electric and magnetic interactions.

The concept of field, introduced in Physics 20, Unit 2: Circular Motion and Gravitation, is applied to magnetic phenomena. The concepts from Physics 20, Unit 1: Kinematics and Dynamics, are applied to charged particle dynamics in magnetic fields. The principles of electromagnetism introduced in Science 9, Unit 4: Electromagnetic Systems are further applied to an investigation of the functioning of electric motors, generators and transformers. The unit concludes with the consideration of the characteristics of the electromagnetic spectrum and alternating current (AC) circuits. This unit provides a foundation for further study of electromagnetic principles in Unit 4 and for post-secondary studies in physics.

The three **major concepts** developed in this unit are:

- magnetic field theory is a model used to describe magnetic behaviour
- electromagnetism pervades the Universe
- electromagnetic radiation is a physical manifestation of the interaction of electricity and magnetism.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from electromagnetic interactions
- connecting, synthesizing and integrating to relate the data to the laws and principles of magnetic forces and fields
- evaluating the process or outcomes of activities investigating the concepts of magnetic forces and fields.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the influence of the needs, interests and financial support of society on scientific and technological research
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate the need for computational competence in quantifying electromagnetic phenomena
- accept uncertainty in the descriptions and explanations of electromagnetic phenomena in the physical world
- be open-minded in evaluating potential applications of electromagnetic principles to new technology
- appreciate the parallelism in the characteristics of electrical, gravitational and magnetic phenomena
- appreciate the fundamental role the principles of electricity and magnetism play in our everyday world
- appreciate the need to follow safe practices when working with electricity
- appreciate the restricted nature of evidence when interpreting the results of electromagnetic interactions.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. Magnetic field theory is a model used to describe magnetic behaviour.	• field theory can be used to describe magnetic interactions, by extending from Physics 20, Unit 1 and Physics 20, Unit 2, and by:
	• explaining the source of magnetic characteristics of matter in terms of magnetic domains
	• comparing the magnetic properties of Earth with those of artificial magnets
	• explaining magnetic interactions in terms of vector fields
	• comparing gravitational, electric and magnetic fields in terms of their sources and directions.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that magnetic interactions are described using field theory; and comparing and contrasting gravitational, electric and magnetic fields and interactions in terms of their source, direction and vectors; and by using field lines to show the shape and orientation of magnetic fields due to a variety of sources, within the context of:
• plotting magnetic fields, using field lines to show the shape and orientation of the magnetic fields resulting from magnetic poles or current-carrying conductors.	• evaluating magnetic field theory as a model to describe and predict observations of magnetic behaviour based on supportive evidence OR • discussing contemporary developments in the areas of electricity and magnetism, and their immediate and potential impact on daily life; e.g., superconductivity OR • investigating and reporting the affects of magnetism on the behaviour of living organisms in terms of the limitations of scientific knowledge and technology and in terms of quality of life OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. Electromagnetism pervades the Universe.	• magnetic forces and fields are described in relation to electric currents, by extending electromagnetic concepts from Science 9, Unit 4, and by:
	• demonstrating how the discoveries of Oersted and Faraday form the foundation of the theory relating electricity to magnetism
	• describing a moving charge as the source of a magnetic field; and predicting the orientation of the magnetic field from the direction of motion
	• predicting, quantitatively, how a uniform electric and/or magnetic field affects a moving electric charge, using the relationships among charge, motion and field direction
	• relating and explaining, qualitatively, the interaction between a magnetic field and a moving charge as to how a magnetic field affects a current-carrying conductor
	• predicting, quantitatively, the effect of an external magnetic field on a current-carrying conductor
	• describing the effects of moving a conductor in an external magnetic field, using the analogy of a moving charge in a magnetic field
	• predicting, quantitatively, the effects of a magnetic field on a moving conductor
	• predicting, quantitatively, and verifying, the effects of changing one, or a combination, of the variables in the relationship $\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{I_s}{I_p}$
	• explaining the relationship between, and calculating, the effective and maximum values of, voltage and current in AC devices, given appropriate information
	• discussing, qualitatively, Lenz's law in terms of conservation of energy; describing, giving examples, situations where Lenz's law applies.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that magnetic forces and fields are related to electric currents; and predicting, quantitatively, the effect of a uniform electric and/or magnetic field on a moving electric charge, and explaining the motor and generator effects; and by analyzing empirical evidence of magnetic field–current interactions, within the context of:
• designing, performing and analyzing experiments demonstrating magnetic field–current interactions	• identifying and analyzing the application of electromagnetic interactions in the functioning of several types of technology OR
• predicting, using the LHR or RHR (hand rules), the relative directions of motion, force and field in electromagnetic devices	• explaining, qualitatively, the design and function of AC and DC motors, generators, meters and other simple electromagnetic devices, using correct scientific terminology OR
• relating the magnetic force, using Newton's second law, to the motion of an electric charge following a curved path in a magnetic field.	• assessing the impact of the transformer and alternating current on the generation, transmission and use of electrical energy, and on quality of life OR
	• evaluating, objectively, electromagnetic biomedical technology, in terms of solving practical problems and the influence of the needs, interests and financial support of society for its development, such as magnetic resonance imaging (MRI) or positron emission tomography (PET) OR
	• analyzing the parallels among gravitational, electrical and magnetic phenomena in terms of empirical evidence, and evaluating the role the conservation laws play in the accumulation of knowledge OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Electromagnetic radiation is a physical manifestation of the interaction of electricity and magnetism.	• Maxwell's theory of electromagnetism expanded on Oersted's and Faraday's generalizations, by:
	• stating that electromagnetic radiation is the result of accelerating electric charges, and demonstrates wavelike behaviour
	• comparing and contrasting the constituents of the electromagnetic spectrum on the basis of frequency, wavelength and energy
	• solving problems algebraically, using the relationships among speed, wavelength, frequency, period and/or distance, of electromagnetic waves
	• comparing and contrasting natural and technological processes by which the major constituents of the electromagnetic spectrum are produced
	• explaining, qualitatively, Maxwell's theory of electromagnetism
	• explaining the propagation of electromagnetic radiation in terms of perpendicular electric and magnetic fields, varying with time, travelling away from their source at the speed of light
	• explaining, qualitatively, how different types of electromagnetic radiation interact with matter, including biological effects; e.g., microwaves, ultraviolet radiation, X-rays.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that electromagnetic radiation is a physical manifestation of the interaction of electricity and magnetism; and explaining the propagation of electromagnetic radiation in terms of electric and magnetic fields; and by demonstrating the wavelike behaviour of electromagnetic radiation; and by predicting the conditions required for electromagnetic radiation emission, within the context of:
• performing experiments, and/or using simulations, demonstrating the wavelike behaviour of electromagnetic radiation • predicting the conditions required for electromagnetic radiation emission.	• evaluating the risks and benefits of using electromagnetic radiation in technological solutions to practical problems; in terms of the quality of life, the limitations of science and technology, and societal needs, interests and financial support OR • researching, reporting on and evaluating the use of electromagnetic radiation technology in such scientific fields as biology, chemistry, medicine, astronomy, in terms of societal needs, interests and financial support, and the contribution to the accumulation of scientific knowledge OR • investigating the requirements and potential of careers, supported by societal needs and interests, involving electromagnetism OR • any other relevant context.

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UNIT 4
NATURE OF MATTER

OVERVIEW

Science Themes: *Energy* and *Matter*

In Unit 4, students investigate the science themes of *energy* and *matter,* as the electric nature of *matter* is considered in the context of developing and understanding of quantum concepts, atomic theory and nuclear processes.

Building on previous learning from Science 10, Unit 3: Energy and Matter in Chemical Change, the discovery of the electron and the development of the quantum model of the atom is studied. The study of the photoelectric effect and the photon model of light provides a link to Physics 20, Unit 4: Light, where the wave model of light is emphasized. The unit concludes with the study of radiation, the characteristics of fission and fusion reactions, quantization of *energy* and how *energy* levels in nature support modern atomic theory. This unit provides a foundation for post-secondary studies in related areas.

The four **major concepts** developed in this unit are:

- the atom has an electric nature
- the photoelectric effect requires the adoption of the photon model of light
- nuclear fission and fusion are nature's most powerful *energy* sources
- *energy* levels in nature support modern atomic theory.

In this unit, *students will develop* an ability to use the **skills** and **thinking processes** associated with the practice of science, emphasizing:

- initiating and planning
- collecting and recording
- organizing and communicating
- analyzing data from experiments, empirical and theoretical evidence for the electron and quantum concepts
- connecting, synthesizing and integrating to relate the data to a theoretical model of the atom, and to the principles of the wave–particle duality of *matter*
- evaluating the process or outcomes of activities investigating quantum concepts and the wave–particle duality of matter.

The **STS connections** in this unit illustrate:

- the central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

ATTITUDES

Students will be encouraged to:

- appreciate that models are modified as new and/or conflicting evidence is presented
- appreciate the role of mathematics in assessing the risks and benefits of radioactivity and the commercial use of nuclear *energy*.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
1. The atom has an electric nature.	• the discovery of the electron contributed to the formulation of quantum concepts and atomic models, by extending from Science 10, Unit 3, and by:
	• explaining how the discovery of cathode rays contributed to the development of atomic models
	• explaining Thomson's experiment and the significance of the results
	• deriving the relationship $\frac{q}{m} = \frac{v}{BR}$, using circular motion and charged particles in electric and magnetic field concepts
	• explaining Millikan's experiment and its significance relative to charge quantization
	• relating the electronvolt, as a unit of energy, to the joule.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding and explaining how technological advances and experimental evidence contributed to the formulation of models of the atom; and by determining the charge to mass ratio of the electron, and the mass of an electron and/or ion, given appropriate empirical data, within the context of:
• performing an experiment, or using simulations, to determine the charge to mass ratio of the electron	• analyzing how the identification of the electron and its characteristics is an example of the interaction of science and technology
	OR
• determining, in quantitative terms, the mass of an electron and/or ion, given appropriate empirical data.	• evaluating how, in the scientific process, discoveries are often missed by investigators failing to identify and/or correctly interpret evidence; e.g., X-rays
	OR
	• any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The photoelectric effect requires the adoption of the photon model of light.	• the quantum concept is required to explain adequately some natural phenomena, by extending from Physics 20, Unit 4, and by:
	• explaining the necessity for Planck to introduce the quantum of energy concept to explain blackbody radiation
	• defining the photon as a quantum of electromagnetic radiation
	• describing how Hertz discovered the photoelectric effect while investigating electromagnetic waves
	• explaining the photoelectric effect in terms of the intensity and wavelength of the incident light and surface material
	• assessing the assumptions made by Einstein in explaining the photoelectric effect
	• defining threshold frequency as the minimum frequency giving rise to the photoelectric effect; and work function as the energy binding an electron to a photoelectric surface
	• explaining the relationship between the kinetic energy of a photoelectron and stopping voltage
	• using Einstein's equation, quantitatively, to describe photoelectric emission
	• describing the photoelectric effect as a phenomenon that supports the notion of the wave–particle duality of electromagnetic radiation
	• explaining X-ray production as an inverse photoelectric effect, and predicting, quantitatively, the short wavelength limit of X-rays produced, given appropriate data
	• explaining, qualitatively, the Compton effect and the de Broglie hypothesis applying the laws of mechanics, conservation of momentum and energy, to photons, as another example of wave–particle duality.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that an adequate explanation of some natural phenomena requires the quantum concept; and describing the photoelectric effect as evidence for the notion of wave–particle duality of electromagnetic radiation; and by investigating, empirically, the photoelectric effect, within the context of:
• performing an experiment demonstrating the photoelectric effect and interpreting the data obtained • predicting and verifying the effect that changing the intensity and/or frequency of the incident radiation or the material of the photocathode has on photoelectric emission.	• analyzing, in general terms, the functioning of various technological applications of the photoelectric effect to solve practical problems; e.g., automatic door openers, burglar alarms, light meters, smoke detectors OR • discussing why the photoelectric effect could not be explained, using the wave model of electromagnetic radiation, and thus required a new hypothesis OR • identifying industrial and scientific uses of X-rays; e.g., X-ray examination of welds, crystal structure analysis OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. Nuclear fission and fusion are nature's most powerful *energy* sources.	• the processes of nuclear fission and fusion are nature's most powerful energy sources, by:
	• using the isotope notation to describe and identify common nuclear isotopes, and determine the number of each nucleon of an atom
	• describing the nature and behaviour of alpha, beta and gamma radiation
	• writing nuclear equations for alpha and beta decay
	• performing simple, nonlogarithmic, half-life calculations
	• predicting the particles emitted by a nucleus from the examination of representative transmutation equations
	• explaining, qualitatively, how radiation is absorbed by matter, and compare and contrast the biological effects of different types of radiation
	• comparing and contrasting the characteristics of fission and fusion reactions
	• explaining, qualitatively, the importance of Einstein's concept of mass–energy equivalence
	• relating, qualitatively, the mass defect of the nucleus to the energy released in nuclear reactions.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the processes of nuclear fission and fusion are nature's most powerful energy sources; and describing the nature of particle radiation and nuclear decay, and explaining, qualitatively, the importance of the concept of mass–energy equivalence in nuclear reaction processes; and by analyzing empirical nuclear decay data, and performing a risk/benefit analysis of a nuclear energy application, within the context of:
• using library resources to research and report on selected scientists who contributed to our understanding of the structure of the nucleus • inferring radiation properties from experimental data provided • graphing data for radioactive decay and interpolating values for half-life • interpreting some common nuclear decay chains • performing a qualitative risk/benefit analysis of a nuclear energy application.	• assessing the value to society of nuclear and particle research OR • evaluating the applications of radiation phenomena and technologies in research, medicine, agriculture, industry; e.g., isotope tracing, food irradiation OR • assessing the risks and benefits of exposure to natural background radioactivity and artificially induced radioactivity; e.g., air travellers to cosmic radiation, dental X-rays OR • evaluating, qualitatively, the risks and benefits of using fission and/or fusion as commercial sources of energy, in terms of the limitations of scientific knowledge and technology, and the ability and responsibility of society to protect the environment and to use natural resources judiciously to ensure quality of life for future generations OR • investigating the requirements and potential of careers, supported by societal needs and interests, involving nuclear physics OR • any other relevant context.

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MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
4. *Energy* levels in nature support modern atomic theory.	• the Rutherford–Bohr model of the atom represents a synthesis of classical and quantum concepts, by:
	• explaining, qualitatively, the significance of the results of Rutherford's scattering experiment in terms of the nature and role of the nucleons; and the size and mass of the nucleus and the atom, which lead to the proposal of a planetary model of the atom
	• explaining why Maxwell's theory of electromagnetism predicts the failure of a planetary model of the atom
	• describing why each element has a unique line spectrum, and comparing and contrasting the characteristics of continuous and line spectra
	• explaining, qualitatively, the conditions necessary to produce line emission and line absorption spectra
	• explaining the quantum implications of the line absorption and the line emission spectra, and determining any variable in the Balmer equation $\frac{1}{\lambda} = R_H\left(\frac{1}{n_{f^2}} - \frac{1}{n_{i^2}}\right)$
	• explaining Bohr's concept of "stationary states" and their relationship to line spectra of atoms; and using the frequency/wavelength of an emitted photon to determine the energy difference between states
	• explaining the relationship between hydrogen's absorption spectrum and its energy levels
	• describing how the Bohr atom can be used to predict the ionization energy of hydrogen, and to calculate the allowed radii of the hydrogen atom
	• describing how the Rutherford–Bohr model has been further refined, by applying quantum concepts to a purely mathematical model based on probability and waves
	• comparing and contrasting, qualitatively, the Rutherford, the Bohr and the quantum model of the atom.

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SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:*
	• understanding that the Rutherford–Bohr model offers a restricted explanation of the structure of the atom, and that a mathematical model provides a fuller explanation of the empirical evidence of energy levels within the atom; and by observing line spectra and predicting potential energy transition in an atom, within the context of:
• observing representative line spectra of selected elements	• investigating and reporting on the use of line spectra in the study of the Universe and the identification of substances
	OR
• predicting the conditions necessary to produce and observe line emission and line absorption spectra	• describing the functioning of lasers in terms of energy level transitions and resonance
	OR
• predicting the potential energy transitions in the hydrogen atom, using a labelled diagram showing the energy levels.	• investigating and reporting on the application of spectra concepts in the design and functioning of lighting devices; e.g., street lights, signs
	OR
	• analyzing how quantum concepts led to technological advances that benefit society; e.g., semiconductors, electron microscopes, computers
	OR
	• investigating and reporting on the contributions made by scientists to the development of the early quantum theory; e.g., Hertz, Planck, Einstein, Bohr, Compton, Davisson, Germer
	OR
	• any other relevant context.

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SCIENCE 20–30

The new senior high school Science 20–30 program has been provincially implemented. The program of studies was sent to schools and school systems in June of 1994. Since then, minor changes have been made to the program, but no further mailout is planned. However, the interim program of studies, dated June 30, 1995, is available for purchase from the Learning Resources Distributing Centre.

SCIENCE 14–24

A. PROGRAM RATIONALE AND PHILOSOPHY

Science by its very nature is interesting, exciting and dynamic. Through the study of science, learners are given an opportunity to explore and understand the natural world and to become aware of the profound influence of science in their lives. Meaningful learning occurs when the study of science is related to what the learners already know, deem personally useful and consider relevant. Learning proceeds best when it originates from a base of concrete experiences that present an authentic view of science. In Science 14–24, students learn science in relevant contexts and engage in meaningful activities. This facilitates the transfer of knowledge to new contexts. Students are encouraged to participate in lifelong learning in science and to appreciate science as a remarkable, inspiring and stimulating human enterprise with practical impact on their lives and on society as a whole.

Science is experimental, creative and imaginative; methods of inquiry characterize its study. In Science 14–24, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop their critical thinking skills. Through experimentation, problem-solving activities and independent study, students develop an understanding of the processes through which scientific knowledge evolves.

The Science 14–24 program places students at the centre. Students are active learners and will assume increased responsibility for their learning as they work through the program. Students are expected to participate actively in their own learning. By working together to solve problems and complete tasks, students will appreciate the value of teamwork.

A thorough study of science is required to give students an understanding of the discipline that encourages them to make appropriate applications of scientific concepts to their daily lives and prepares them for future studies in science. An emphasis on the major concepts and principles of science provides students with a broader view of the sciences and a greater awareness of the connections among them.

These science learnings will take varying amounts of time to acquire, depending on the individual learning styles and abilities of students. While each course is designed for approximately 125 hours, instructional time can be modified to meet the individual needs of students. Some students will require more than 125 hours, while others will require less.

GOALS

The major goals of the Science 14–24 program are:

- to develop in students an understanding of the major ideas and principles in the natural science disciplines
- to provide students with an enhanced understanding of scientific inquiry
- to help students attain scientific awareness and prepare for citizenship in a scientifically literate society
- to provide students with challenging and relevant learning opportunities that lay the foundation for meeting the demands of the workplace
- to provide students with opportunities for acquiring knowledge, skills and attitudes that contribute to personal development.

Science 14–24 is a general science program that helps students better understand and apply fundamental concepts and skills common to biology, chemistry, physics and environmental science. The Science 14–24 program will allow students to meet the credit requirements for a high school diploma. The focus is on helping students understand the scientific principles behind the natural events they experience and the technology they use in their daily lives. The program encourages enthusiasm for scientific inquiry and develops positive attitudes about science as an interesting human activity with personal meaning. It will develop in students the knowledge, skills and attitudes to help them become capable of, and committed to, setting goals, making informed choices and acting in ways that will improve their own lives and life in their communities.

B. GENERAL LEARNER EXPECTATIONS

ATTITUDES

1. Scientific Attitudes

Students will be encouraged to develop the affective attributes of scientists at work, including:

- 1.1 curiosity
- 1.2 respect for evidence
- 1.3 inclination to tolerate uncertainty
- 1.4 intellectual honesty
- 1.5 open-mindedness
- 1.6 critical-mindedness
- 1.7 perseverance
- 1.8 creativity and inventiveness
- 1.9 appreciation for group work
- 1.10 suspended judgment
- 1.11 objectivity
- 1.12 confidence in personal ability
- 1.13 respect for accuracy and precision.

2. Attitudes toward Science

Students will be encouraged to develop the feelings, opinions, beliefs and appreciations that individuals have formed as a result of interacting with the various aspects of the scientific enterprise, including:

- 2.1 a positive attitude toward mathematical and scientific process skills
- 2.2 an appreciation for the utility of computational competence and problem-solving skills
- 2.3 an appreciation that, in solving problems scientifically, new technologies develop
- 2.4 an appreciation of the roles that science and technology play in serving human needs
- 2.5 an appreciation of the need for problem solving and informed decision making at both personal and societal levels
- 2.6 an appreciation of the contributions science and mathematics have made to our cultural heritage and civilization
- 2.7 an appreciation of the contributions and limitations of scientific and technological knowledge to societal decision making
- 2.8 an appreciation that ethical dilemmas may arise from the application of scientific research and/or technological developments
- 2.9 a sensitivity to the living and non-living environment
- 2.10 an appreciation of the roles of science and mathematics in explaining the complexity of the natural world.

SKILLS

1. Initiating Skills

Students will be expected to demonstrate an ability to distinguish between relevant and irrelevant information early in the cognitive process by:

- 1.1 defining problems
- 1.2 identifying issues
- 1.3 setting goals by establishing direction and purpose
- 1.4 formulating questions to guide research/inquiry
- 1.5 identifying variables and assumptions.

2. Information-gathering and Data-collecting Skills

Students will be expected to demonstrate an ability to consciously consider the substance or content to be used in the cognitive process by:

- 2.1 using an experimental design or research plan to gather data/ information
- 2.2 obtaining qualitative and quantitative data
- 2.3 accessing relevant information
- 2.4 assembling and effectively using apparatus and equipment
- 2.5 recording data.

3. Organizing Skills

Students will be expected to demonstrate an ability to arrange or structure information so it can be understood or presented more readily by:

- 3.1 classifying
- 3.2 comparing/contrasting
- 3.3 ordering and identifying patterns and trends
- 3.4 drawing graphs, charts, flow charts, maps and diagrams
- 3.5 expressing data in the form of a mathematical relationship.

4. Analyzing Skills

Students will be expected to demonstrate an ability to classify existing information by examining parts and relationships, and to identify and distinguish components, attributes, claims, assumptions or reasons by:

- 4.1 interpreting data or information
- 4.2 judging the reliability or validity of the data or information
- 4.3 identifying errors
- 4.4 distinguishing between facts and values; relevant and irrelevant information
- 4.5 identifying main ideas
- 4.6 identifying attributes and components
- 4.7 identifying relationships and patterns
- 4.8 identifying perspectives
- 4.9 detecting bias and inconsistencies in a line of reasoning.

5. Generating Skills

Students will be expected to demonstrate an ability to make connections between new ideas and prior knowledge, and to add information beyond what is given by:

- 5.1 predicting
- 5.2 hypothesizing
- 5.3 explaining and elaborating
- 5.4 inferring and generalizing from the data or information
- 5.5 designing experiments or devising a plan for research
- 5.6 identifying and developing alternatives
- 5.7 identifying further problems, questions and issues to be investigated.

6. Integrating Skills

Students will be expected to demonstrate an ability to combine new information and prior knowledge by:

- 6.1 summarizing and communicating findings
- 6.2 developing consensus within a group
- 6.3 making a decision; developing a conclusion/solution
- 6.4 incorporating new information into existing theories or knowledge
- 6.5 changing existing knowledge structures to incorporate new information.

7. Evaluating Skills

Students will be expected to demonstrate an ability to assess the logic and quality of ideas and information by:

- 7.1 considering consequences
- 7.2 establishing criteria to judge reliability and validity of the data or information
- 7.3 assessing a design or the approach taken to solving problems and decision making
- 7.4 assessing the achievement of the goals set and action taken.

CONCEPTS

1. Foundation of Knowledge in the Natural Sciences

Students will be expected to demonstrate an understanding of ideas fundamental to science, including:

- 1.1 matter has structure and composition, and there is an interaction among its components
- 1.2 matter and energy are conserved in reaction systems

1.3 living organisms are interdependent with one another and with their environment
1.4 life forms exhibit uniquity, diversity and a changing nature
1.5 physical laws and theories attempt to explain the universe
1.6 chemical and physical systems are in a state of dynamic equilibrium
1.7 the application of knowledge is part of a systematic interpretation of natural phenomena.

2. Nature of Science

Students will be expected to demonstrate an understanding of science as a disciplined way to develop explanations for natural phenomena, including:

2.1 empirical evidence plays an important role in the development of scientific knowledge
2.2 scientific explanations are developed through interpretations and conceptual inventions that are theoretical in nature
2.3 proposed theories may be supported or refuted by experimental evidence
2.4 scientific knowledge is cumulative and subject to change.

3. Science and Technology

Students will be expected to demonstrate an understanding of the interaction between science and technology, including:

3.1 technology is a process of solving practical problems
3.2 technological development includes both products and processes
3.3 technology is a rapidly evolving area in modern society requiring ongoing study
3.4 the functioning of products and processes may be explained using scientific knowledge
3.5 science can be used to advance technology, and technology can be used to advance science
3.6 scientific knowledge and technology have limitations.

4. Science, Technology and Society

Students will be expected to demonstrate an understanding of how science and technology influence, and are in turn influenced by, societal issues, including:

4.1 many of the effects of science and technology on society are unforeseen
4.2 societal factors, such as economic, political, ethical and moral forces, interact with science and technology, exerting significant influence on each
4.3 technological products and processes develop in response to societal needs and wants
4.4 compromises are often needed to arrive at workable situations involving science and technology in society
4.5 various societal decisions can be evaluated in terms of related scientific and technological thinking
4.6 the scientific, technological and societal aspects of an issue can be identified through appropriate research and communication.

C. SPECIFIC LEARNER EXPECTATIONS

The Science 14–24 program has a required and an elective component, defined as follows:

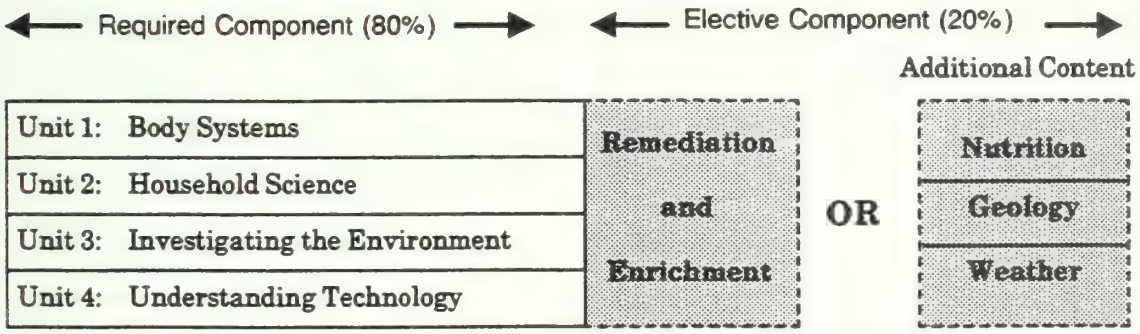
- the required component provides the specific learner expectations within the required units of study, and comprises 80% of the program
- the elective component provides opportunities to adapt and enhance instruction to meet the diverse needs, abilities and interests of individual students. This component of the course may consist of remediation and enrichment or one of the optional units outlined below, and comprises 20% of the program.

The elective component can be used for:

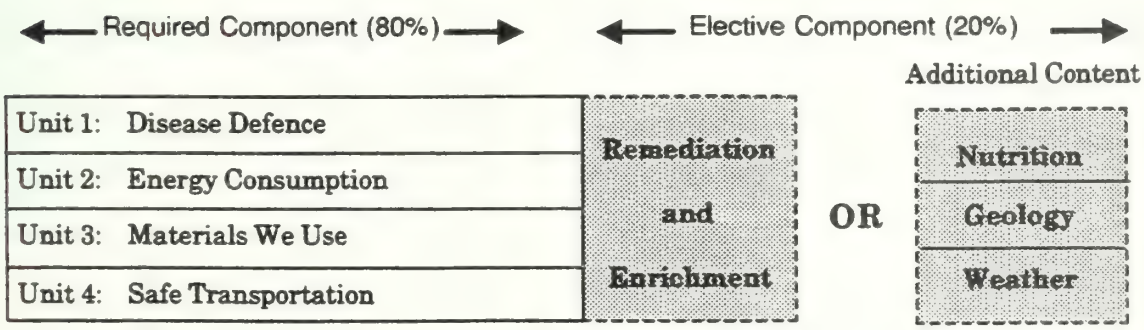
- enrichment of the required component of the program to provide challenges and depth
- remediation of the required component to provide additional assistance and reinforcement
- additional learning to provide alternative instructional activities consistent with the learner expectations of the required component.

For each of Science 14 and Science 24, four required units must be completed.

SCIENCE 14 (5 Credits)



SCIENCE 24 (5 Credits)



Elective time should be spent in a manner best suited to the nature and needs of the learner.

Three optional units are provided. Optional units serve as possible elective component material, either as enrichment or additional content. A teacher may select one or more of these suggested optional units to serve as elective for either the Science 14 or Science 24 courses. These optional units are not intended to be prescriptive but to serve as models. Optional units may be developed or selected locally, subject to the following provisions being met.

1. All optional program content must support the general learner expectations of the program.

2. Inclusion of optional content must not detract from the achievement of the specific learner expectations of the required component of the program.

Any optional unit taught becomes part of the 20% elective component of the program. Additional topic suggestions are included in the *Science 14–24 Teacher Resource Manual*, 1989.

SCIENCE 14

REQUIRED UNIT 1: BODY SYSTEMS

Overview

Through the application of scientific investigation, and the incorporation of simple monitoring technology, students will be encouraged to develop an understanding of the human body as a collection of dynamically balanced processes. The contribution of science to the current knowledge and technology associated with the functioning human body will be identified. Knowledge gained should be personally applicable and form a foundation for understanding the life processes of all living organisms.

Attitudes

Students will be encouraged to:

- appreciate the potential for advancement of knowledge through scientific inquiry
- respect the method of scientific investigation for its contribution to current knowledge of body systems and their interactions
- value the contribution of technology to the scientific investigations related to human health
- appreciate the intricate workings and balance within the human body
- value knowledge gained for its usefulness on a personal level
- value knowledge gained for its general application to all living things.

Skills

Students will be expected to demonstrate an ability to:

- question, observe, measure, collect, process and interpret data while investigating body systems
- apply monitoring technology in the collection of personal data for analysis.

Concepts

1. *Students will be expected to* demonstrate an understanding that science is a disciplined way to develop explanations for body functions.

    1.1 Illustrate with an example that much of our current knowledge of body systems has developed as a result of scientific inquiry.
    1.2 Outline a scientific investigation of a specific body function.
    1.3 Deduce that the knowledge of body systems is constantly expanding through scientific research.

2. *Students will be expected to* demonstrate an understanding that medical technology can be used to monitor body conditions.

    2.1 Describe the role of technology in monitoring critical life functions.
    2.2 Describe the contribution of technology to the diagnosis of malfunction within body systems.
    2.3 Explain, using an example, how science and technology work together to expand knowledge of body systems, providing information that can be applied to prevention of potential problems.
    2.4 Describe how technology can intervene to preserve the balance of life when a system fails (temporary and permanent intervention).

3. *Students will be expected to* demonstrate an understanding that a healthy body is the product of body systems working in harmony.

    3.1 Identify the critical life functions and the body system(s) that performs them.
    3.2 State how each body system has a particular function critical to life.
    3.3 Describe two body systems and their functions.

3.4 List the structures within those two body systems.
3.5 State the functions associated with each of those structures within the two systems.
3.6 Analyze the functional relationship of the two systems.

4. *Students will be expected to* demonstrate an understanding that the interrelationships of body systems are critical to life.

4.1 Explain how normal fluctuation within one body system results in adjusting fluctuations in other body systems.
4.2 Analyze the effect of a major fluctuation within the normal limits of one of the two systems studied.
4.3 Extrapolate the concept to include the interrelationships of all body systems.
4.4 Deduce that illness, and possibly death, results when the body cannot accommodate major disturbances within one or more of its systems.

5. *Students will be expected to* demonstrate an understanding that living things share common life functions.

5.1 Describe how critical life functions are performed by unicellular organisms, plants and animals.
5.2 Generalize and apply knowledge gained about human life functions to other living systems.

REQUIRED UNIT 2: HOUSEHOLD SCIENCE

Overview

By carrying out a series of controlled experiments, students will identify properties of substances found in their homes. They will be expected to develop a strategy for the safe handling of potentially dangerous substances and situations encountered within the home environment.

Attitudes

Students will be encouraged to:

- value scientific principles and processes for their usefulness in providing an understanding of common household phenomena
- appreciate that science exists outside of the classroom and laboratory
- value measurement for its usefulness in the household
- appreciate the benefit and potential danger of common household chemicals
- appreciate the contribution of technological products and processes to the modern household.

Skills

Students will be expected to demonstrate an ability to:

- improve measurement skills
- refine observation skills
- use data collecting, processing and interpreting skills
- communicate experimental results clearly
- read consumer labels and reports with accuracy and understanding
- determine household product composition through investigation and/or accurate label reading
- determine the properties of pure substances and solutions through investigation
- apply acid and base identification techniques
- protect living organisms and materials from excessive heat transfer
- handle food safely
- handle potentially dangerous household products safely.

Concepts

1. *Students will be expected to* demonstrate an understanding that household activities often require knowledge of measurement techniques.

1.1 Use a variety of measurement techniques common in a household.

1.2 Use common household measurement devices correctly.

2. *Students will be expected to* demonstrate an understanding that household products and processes are based on the principles of science.

   2.1 Identify some basic household processes, such as cleaning, laundry, baking and painting that are based on scientific principles.
   2.2 Identify the products involved in these processes; e.g., detergents, leavening agents, solvents.
   2.3 Explain the composition of a household product.
   2.4 Describe the scientific principles that underlie the effectiveness of a household product or process.

3. *Students will be expected to* demonstrate an understanding that the properties of solutions are different than those of pure substances.

   3.1 Describe the properties of solutions and pure substances.
   3.2 Identify solutions found in a household.
   3.3 Identify pure substances found in a household.
   3.4 Differentiate solutions and pure substances, using selected household examples.

4. *Students will be expected to* demonstrate an understanding that permanent suspensions are found in the home.

   4.1 Describe the properties of permanent suspensions.
   4.2 Identify common permanent suspensions found in the home.
   4.3 Deduce the importance of permanent suspension by examining the consequences of separation to relevant household products.

5. *Students will be expected to* demonstrate an understanding that acids and bases can be identified and their reactions observed in the home.

   5.1 Describe the necessity for accurate identification of these substances.
   5.2 Describe how acids and bases can be identified.
   5.3 Illustrate with an example how acids and bases can react with other household substances in both useful and potentially dangerous ways.

6. *Students will be expected to* demonstrate an understanding that solubility varies with temperature change.

   6.1 Demonstrate how temperature change affects solubility of one common household solute.
   6.2 Cite common household examples of temperature change affecting solubility; e.g., brine preparation in pickling, syrup preparation in canning of fruit, making jello, homemade syrup.
   6.3 Describe why certain solutes crystallize out as temperature drops, and explain the concept of saturation point.

7. *Students will be expected to* demonstrate an understanding that reactions may require or emit energy in the form of heat.

   7.1 Describe the types of household reactions that require heat.
   7.2 Describe different household chemical reactions that would produce heat.
   7.3 Evaluate the usefulness of household reactions that require or emit heat.

8. *Students will be expected to* demonstrate an understanding that heat flows from areas of high temperature to areas of lower temperature.

   8.1 Compare heat exchange by conduction, convection and radiation in different mediums.

8.2 Determine the mode of heat transfer involved in various household processes.
8.3 Describe how household products, devices and techniques are designed to increase or decrease heat flow for specific purposes.
8.4 Describe the potential dangers of heat transfer.

9. *Students will be expected to* demonstrate an understanding that many household substances require special care in their use and handling.

9.1 Identify substances that have safety labelling.
9.2 List reasons why reading instructions for safe handling are important.
9.3 Describe recovery techniques for common problems or errors in handling.
9.4 List the potential dangers of mixing common household products.
9.5 Describe how micro-organisms can have beneficial and harmful effects on food material in the home.

REQUIRED UNIT 3: INVESTIGATING THE ENVIRONMENT

Overview

Students will identify a problem that arises from a selected environmental issue. They will investigate the problem, identify any technology relating to the problem, and suggest a process or action plan to deal with the selected environmental issue.

Attitudes

Students will be encouraged to:

- appreciate the fragility of the biosphere
- realize our inability to anticipate the environmental effects of our human activities
- develop optimism with respect to humankind's ability to live in harmony with the environment
- develop a sense of personal responsibility and empowerment in relation to environmental issues
- appreciate that the collective action of individuals can have significant impact
- develop healthy skepticism in regard to technology as the ultimate solution to environmental issues
- appreciate that environmental issues involve significant relationships among science, technology and society.

Skills

Students will be expected to demonstrate an ability to:

- identify a problem associated with an environmental issue
- gather, organize and evaluate such information
- clearly communicate the results of the investigation
- apply resulting information to a personal and/or societal situation.

Concepts

1. *Students will be expected to* demonstrate an understanding that humans have the ability to influence the quality of the environment.

1.1 List technological developments that produce materials the ecosystem cannot recycle.
1.2 Identify the relationship between densely populated areas and the production of wastes that exceed the environment's capacity to recycle.
1.3 Describe how land-use practices may result in major changes to the environment.
1.4 Give examples of how technological and societal developments can improve the quality of the environment.

2. *Students will be expected to* demonstrate an understanding that science and technology influence, and are influenced by, societal issues.

   2.1 Give examples of how science and technology develop in response to societal needs.
   2.2 Describe how scientific and technological developments, while meeting human wants and needs, may create or intensify problems; e.g., pollution.

3. *Students will be expected to* demonstrate an understanding that the effects of science and technology on society and on the environment are often unforeseen.

   3.1 Identify examples of the unforeseen consequences of science and technology; e.g., nuclear fission, automobiles, herbicides and pesticides.
   3.2 Identify and analyze the circumstances that led to unforeseen consequences in one particular case.
   3.3 Evaluate the societal impact of a development in science and technology.

4. *Students will be expected to* demonstrate an understanding that individuals can become involved in the resolution of ecological problems that arise.

   4.1 Identify ways that society can affect science and technology, exercising some degree of direction and control through political and consumer pressure; e.g., provision of fiscal and manpower resources, legislation, enforcement, petition, voting, demonstrations.
   4.2 Identify the ways an individual, as a member of society, can provide a degree of direction and control for science and technology; e.g., letters to MPs, lobby groups, personal habits.

5. *Students will be expected to* demonstrate an understanding that the biosphere is a thin layer on the surface of the earth, able to support life.

   5.1 Identify the components of the biosphere that provide the essentials of life.

6. *Students will be expected to* demonstrate an understanding that a continuous supply of solar energy is essential to life.

   6.1 Describe how the flow of solar energy through the biosphere is non-cyclical.
   6.2 Explain how photosynthesis and respiration are involved in the energy conversions necessary for life.
   6.3 Trace energy transfer from one feeding level to another, identifying loss of heat energy at each transfer.

7. *Students will be expected to* demonstrate an understanding that life depends on recycling processes.

   7.1 Explain why biochemical cycles are necessary to recycle matter.
   7.2 Identify the role of decomposers in the recycling process.
   7.3 Specify how biodegradable materials reduce the impact of human-made products on the environment.

8. *Students will be expected to* demonstrate an understanding that an ecosystem is the interaction of a community with its physical environment.

   8.1 List the physical factors that limit population growth.
   8.2 Describe how interaction between organisms affects populations.
   8.3 Illustrate, with at least one example, the impact organisms have on the environment.

REQUIRED UNIT 4: UNDERSTANDING TECHNOLOGY

Overview

Students will construct and/or manipulate and examine a simple device to determine the scientific principles upon which the operation of the device depends.

Attitudes

Students will be encouraged to:

- develop a positive attitude toward scientific and technological processes and skills
- appreciate that in solving problems scientifically, new technologies develop
- develop an awareness that science may involve technology and technology may involve science
- appreciate the importance of evaluating the design of a given technological device
- appreciate the relationships among science, technology and society.

Skills

Students will be expected to demonstrate an ability to:

- select and observe natural phenomena
- select a current technology and identify the specific interrelationships that exist between science and technology
- construct or acquire at least one simple device
- test the operation of the device
- evaluate the performance of the device
- identify the scientific principles used by the device
- identify a need or want not currently satisfied by a modern technology
- create an original design for one of the above needs or wants
- communicate how a specific technology has personal application.

Concepts

1. *Students will be expected to* demonstrate an understanding that science is the study of natural phenomena.

    1.1 Illustrate, with at least one example, how observation of natural phenomena can lead to scientific inquiry.
    1.2 Specify, using at least one example, how scientific principles stem from scientific inquiry.

2. *Students will be expected to* demonstrate an understanding that science is founded on facts, laws and theories.

    2.1 Differentiate among the terms *fact*, *law* and *theory*.
    2.2 Identify the relevant scientific facts, laws and theories associated with the use of simple devices or observable phenomena.

3. *Students will be expected to* demonstrate an understanding that science can be used to advance technology, and technology can be used to advance science.

    3.1 Identify situations where science leads to advances in technology.
    3.2 Identify situations where technology leads to advances in science.

4. *Students will be expected to* demonstrate an understanding that people create technological devices and systems to satisfy needs and wants.

    4.1 Illustrate, with at least one example, the application of scientific principles in the development of modern devices.
    4.2 Identify a variety of human needs and wants, and list the technological devices developed to meet them.

SCIENCE 24

REQUIRED UNIT 1: DISEASE DEFENCE

Overview

Students are to become aware of common diseases and their affect on our society. The technology involved in the study, treatment and cure of these diseases will be investigated.

The human immune system, immunization and current related biotechnology will be major areas of study.

Attitudes

Students will be encouraged to:

- appreciate that in solving problems scientifically, new technologies often develop
- appreciate that ethical dilemmas may arise from the application of scientific research and/or technological developments
- appreciate the relationship among science, technology and society
- develop a responsible attitude toward disease prevention
- develop an awareness of the limits of science and technology in regard to control and cure of human disease.

Skills

Students will be expected to demonstrate an ability to:

- identify, use and evaluate various methods of problem solving
- apply data collection, organization and interpretation skills
- recognize the limits of science and technology
- develop skill in the use of a light microscope/microslide viewer
- observe and identify basic cell structures visible under the light microscope/microslide viewer
- implement basic principles of disease prevention that contribute to human health.

Concepts

1. *Students will be expected to* demonstrate an understanding that diseases can be communicable or non-communicable.

   1.1 Trace the historical development of the disease concept.
   1.2 Describe how communicable diseases are transmitted by microbes, such as viruses, bacteria, protists and fungi.
   1.3 Describe how non-communicable diseases result from an interaction of variables; e.g., poor nutrition, compromised immune system, stress, heredity, alcohol, smoking.
   1.4 Describe the steps that can be taken to reduce the risk of contracting disease.

2. *Students will be expected to* demonstrate an understanding that the microscope is an essential tool for looking at microbes and cells.

   2.1 Relate structure to function in a light microscope.
   2.2 Describe how the invention of the electron microscope made possible the study of viruses and extremely small structures within the cell, which in turn led to great advances in science.

3. *Students will be expected to* demonstrate an understanding that the human body has natural systems of immunity.

   3.1 Describe how immunity can be achieved through contact with specific diseases.
   3.2 Describe how antibodies and phagocytes function as major components of the body's defence/immune system.
   3.3 Explain that through placental transfer and breast milk, maternal system antibodies pass to the offspring, providing some degree of immunity to the child.

3.4 Identify examples of abnormal immune responses; e.g., allergies, AIDS.

4. *Students will be expected to* demonstrate an understanding that biotechnical and biomedical processes have greatly enhanced our immune systems.

4.1 Explain why an aseptic technique is critical to modern medical practice (historical development).
4.2 Relate how artificial immunization (vaccines) prevents the contraction of many diseases.
4.3 Describe how antibiotics suppress bacterial growth.
4.4 Identify advances in genetic research that relate to disease defence; e.g., the splicing and cloning of genes to make antibodies.

5. *Students will be expected to* demonstrate an understanding that immunization technology is based on scientific principles.

5.1 Trace the historical development of immunization therapy (Jenner, Pasteur, Koch, Salk).
5.2 Describe how the body recognizes a foreign substance (antigen) and can produce specific antibodies against it.
5.3 Describe how immunity can be induced by injection with attenuated or killed micro-organisms; e.g., measles, mumps, polio, rabies.
5.4 Outline how injection of antibodies directly into an individual results in passive immunity; e.g., tetanus, hepatitis.

6. *Students will be expected to* demonstrate an understanding that factors behind biotechnical and biomedical processes have societal implications.

6.1 Explain that vaccines provide immunity against diseases that were formerly fatal.
6.2 Cite two examples of transplants or implants that may increase life expectancy.
6.3 Identify and describe two techniques for genetic screening that make it possible to detect genetically transmitted diseases and disorders.
6.4 Describe the interaction of a biomedical process with science and society.
6.5 Cite one example of scientific research into the diseases of domestic crop plants leading to the development of technology that resulted in the production of disease-resistant strains.

REQUIRED UNIT 2: ENERGY CONSUMPTION

Overview

Students will use observation and recording of personal energy consumption patterns to establish a data base. Analysis and application of this data should lead to an awareness of technological processes involved in personal and global energy consumption.

Attitudes

Students will be encouraged to:

- develop a positive attitude toward mathematical and scientific process skills
- develop responsible attitudes toward energy consumption in relation to personal and global needs
- be receptive to new ideas, insights and change.

Skills

Students will be expected to demonstrate an ability to:

- select and apply appropriate problem-solving strategies
- apply specific data collection, organization and interpretation skills
- identify trends in data, and make predictions from those trends
- use precise symbols and terminology
- use simple calorimetry to measure the energy output of various foods
- use simple equipment and techniques to measure two other forms of energy; e.g., light, sound

- apply monitoring techniques, and record personal kilojoule intake
- analyze data from a personal kilojoule intake record
- develop an improved diet plan based on the analysis
- apply monitoring techniques, and record a personal household's energy consumption
- analyze data from a personal household energy consumption record
- devise a more efficient plan for household energy consumption based on the analysis
- devise a simple energy system model to demonstrate the conservation of energy
- calculate the efficiency of a basic energy system.

Concepts

1. *Students will be expected to* demonstrate an understanding that we obtain energy from the foods we consume.

    1.1 Identify the sun as the ultimate source of food energy.
    1.2 Describe the body systems responsible for conversion of food into energy.
    1.3 Identify and describe the processes of energy conversion performed by the human body.
    1.4 Identify the basic components of a balanced diet.

2. *Students will be expected to* demonstrate an understanding that energy can be measured in quantitative terms.

    2.1 Identify and define the units for measuring energy from food.
    2.2 Examine calorimetric equipment and techniques for measuring food energy.
    2.3 Identify other forms of energy present in the world.
    2.4 Identify equipment, techniques and units used to measure other forms of energy.

3. *Students will be expected to* demonstrate an understanding that personal energy consumption can be determined.

    3.1 Identify the forms of energy used in the household.

4. *Students will be expected to* demonstrate an understanding that observable phenomena play a role in the development of scientific knowledge.

    4.1 Describe how energy consumption data can be applied to make energy use more efficient.

5. *Students will be expected to* demonstrate an understanding that energy within a system has input, conversion and output components.

    5.1 Identify the energy components within a system.
    5.2 Describe the flow of energy within the human body.
    5.3 Describe the flow of energy through an ecosystem.
    5.4 Investigate energy consumption, conversion and output within an energy-powered device.

6. *Students will be expected* to demonstrate an understanding that total energy of a system is conserved.

    6.1 State the law of conservation of matter and energy.
    6.2 Explain the law of conservation of energy in terms of a selected energy system model.

7. *Students will be expected to* demonstrate an understanding that efficiency of an energy system can be calculated.

    7.1 Describe the methods and techniques for determining the efficiency of an energy system.
    7.2 Suggest ways of improving the efficiency rating of an energy system.
    7.3 Compare and contrast two energy systems in terms of their overall efficiency.

8. *Students will be expected to* demonstrate an understanding that there are renewable and non-renewable energy sources.

    8.1 Differentiate between renewable and non-renewable energy sources.

8.2 Identify and describe one renewable and one non-renewable energy source.
8.3 Describe ways of using renewable energy sources to improve the efficiency of local and global energy consumption.
8.4 Discuss the effects of using non-renewable sources on local and global energy consumption.

REQUIRED UNIT 3: MATERIALS WE USE

Overview

Students will study a variety of materials and their application. The interaction of science and technology in the research, development and production of materials to satisfy a societal demand will be addressed. The relationship of the properties of a specific material to its application will become evident through personal scientific investigation.

Attitudes

Students will be encouraged to:

- be aware that the technology of materials can solve practical problems
- appreciate the relationship of science principles to the properties of common materials
- appreciate the contribution of scientific processes and skills to the research and development of the technology of materials.

Skills

Students will be expected to demonstrate an ability to:

- design an experiment to investigate several properties of a selected material(s)
- carry out the experimental design on a selected material(s)
- apply data collection, organization and interpretation skills
- communicate results clearly
- propose applications of the selected material(s), based on its properties
- assess materials critically.

Concepts

1. *Students will be expected to* demonstrate an understanding that a material is the substance of which a thing is, or from which it can be made.

   1.1 Define *matter.*
   1.2 Define the atom as the basic structural unit of matter.
   1.3 Relate the behaviour of atoms and molecules to the kinetic molecular theory.
   1.4 Relate the properties of a material to its composition.

2. *Students will be expected to* demonstrate an understanding that the properties of materials can be investigated through controlled experimentation.

3. *Students will be expected to* demonstrate an understanding that the technological process of producing a product can be evaluated.

   3.1 Describe how products are derived from natural or synthetic sources.
   3.2 Identify products that are in everyday use.
   3.3 Investigate the industrial process involved in the manufacture of two products.
   3.4 State the advantages and disadvantages of the industrial processing of resources into a product.

4. *Students will be expected to* demonstrate an understanding that the use of materials has changed many aspects of life.

   4.1 Describe how non-biodegradable products can cause environmental problems.
   4.2 Assess the need for biodegradable products.
   4.3 Describe how products and their applications can change over time as new materials and technologies are developed.
   4.4 List the properties of four selected raw materials and identify their contribution to our quality of life.

REQUIRED UNIT 4: SAFE TRANSPORTATION

Overview

Students will study the scientific principles associated with transportation. The rationale for the technology involved in transportation safety should evolve from this study. An issue related to transportation safety should be thoroughly investigated, and the student should develop an informed opinion regarding this issue.

Attitudes

Students will be encouraged to:

- appreciate a philosophy of life that reflects personal responsibility
- appreciate that ethical dilemmas may arise from the application of technological developments
- appreciate the relationship among science, technology and society with respect to transportation
- accept the need for rules and regulations with respect to transportation safety.

Skills

Students will be expected to demonstrate an ability to:

- select and apply appropriate problem-solving strategies
- apply data collection, organization and interpretation skills
- apply deductive reasoning to arrive at a conclusion
- analyze the possible impact of technological developments on society
- identify the limits of science and technology
- debate the relationship between consumers' expectations and producers' responsibilities
- implement principles of transportation safety that will contribute to lifelong health and survival.

Concepts

1. *Students will be expected to* demonstrate an understanding that collisions involve the conservation of energy.

   1.1 Relate the momentum of an object to its mass and velocity.
   1.2 Specify that moving objects possess energy of motion called kinetic energy.
   1.3 Relate the energy transferred in a collision to the direction of the moving objects involved.
   1.4 Trace the energy conversions in a collision.

2. *Students will be expected to* demonstrate an understanding that personal risk involved in the use of technology can be assessed.

   2.1 Investigate how different modes of travel present different types and degrees of personal risk.
   2.2 Relate the condition and expertise of the vehicle operator to the degree of risk involved.
   2.3 Relate environmental conditions to travel safety.
   2.4 Describe how risk may be reduced by use of safety devices and practices.

3. *Students will be expected to* demonstrate an understanding that trade-offs are made to arrive at safe, workable situations involving technology in society.

   3.1 Assess the influence of cost on the development and consumer acceptance of safety devices.
   3.2 Assess the influence of comfort on the design and use of safety devices.
   3.3 Assess how convenience influences safe transport.
   3.4 Consider the issues of vehicle appearance and popularity in relation to vehicle safety.

4. *Students will be expected to* demonstrate an understanding that science and technology influence societal issues.

    4.1 Illustrate, with at least one example, that technological development occurs in response to the perceived needs and wants of society.
    4.2 Describe how scientific and technological developments provide wider choices for private and industrial society.

5. *Students will be expected to* demonstrate an understanding that safety features are involved in making societal decisions regarding transportation technology.

    5.1 Identify how vehicle safety is determined by extensive research and setting of standards.
    5.2 State the safety standards and licencing requirements for operators of vehicles such as motorcycles, bicycles and cars.
    5.3 State the need for safe transportation corridors.
    5.4 Describe how properly designed and strategically placed road signs and traffic control devices contribute to road safety.

SUGGESTED OPTIONAL UNIT: NUTRITION

Overview

The students will obtain the latest information on nutrition that will provide them with the background necessary for considering alternatives prior to making decisions concerning their personal health or the health of others in our society.

Attitudes

Students will be encouraged to:

- appreciate the relationship between diet and lifestyle
- develop a responsible attitude toward tobacco, alcohol and drugs
- develop a philosophy reflecting responsibility to self and others
- appreciate the ethical dilemmas that may arise from the application of scientific research and/or technological developments.

Skills

Students will be expected to demonstrate an ability to:

- devise a personal strategy for maintaining a healthy body; emphasizing prevention of potential problems
- examine evidence and consider alternatives before making a decision
- examine and assess a variety of viewpoints on controversial issues before forming an opinion
- relate individual needs to societal concerns
- recognize the technological advancements in health care related to nutrition
- classify foods into groups as outlined in the *Canada Food Guide*
- perform specific laboratory tests to identify proteins, fats and carbohydrates in foods
- collect and analyze personal food intake data
- interpret the terminology found on food labels
- use labels on prepackaged foods to classify the ingredients into nutrient or non-nutrient categories.

Concepts

1. *Students will be expected to* demonstrate an understanding that daily food intake should include minimal amounts of certain foods in order to maintain health.

    1.1 Define *nutrient*.
    1.2 Review the *Canada Food Guide* definition of good nutrition.
    1.3 Define and give examples of *carbohydrates*, *fats* and *proteins*.
    1.4 Identify the major functions of carbohydrates, fats and proteins in the human body.
    1.5 Deduce that many foods are combinations of carbohydrates, fats and proteins.
    1.6 Explain why a healthy diet consists of a balance of foods from each group.
    1.7 Explain the general role of vitamins and minerals in the body, and identify common sources of these nutrients.
    1.8 Describe Canada's food-labelling laws and how they assist the consumer in selecting foods with appropriate nutrients.

2. *Students will be expected to* demonstrate an understanding that much of our food, particularly processed food items, contain additives.

    2.1 Define *additive*.
    2.2 List common food additives found in or on foods.
    2.3 Identify the function of these additives.
    2.4 Outline Canada's labelling laws regarding additive listing.
    2.5 Discuss the benefits of labelling laws to the consumer.

3. *Students will be expected to* demonstrate an understanding that alcohol, drugs and tobacco can relate to nutrition.

    3.1 Define *alcohol* and *drugs*.
    3.2 Analyze the effects of alcohol, drugs and tobacco on an individual's appetite and nutritional needs.
    3.3 Describe a specific disease related to each of alcohol, drug and tobacco abuse.
    3.4 Relate these diseases to the effects on nutrition.

4. *Students will be expected to* demonstrate an understanding that the consequences of improper diet can range from minor deficiencies to life-threatening conditions.

    4.1 Specify how a lack of vitamins or minerals may lead to deficiency diseases.
    4.2 Describe how fad diets and packaged meal supplements may lack essential food groups, minerals and vitamins, and may be hazardous to one's health.
    4.3 Define/describe *anorexia* and *bulimia*.
    4.4 State why anorexia and bulimia are life threatening.
    4.5 Cite at least one example of technological advancement in health care related to nutrition.
    4.6 Analyze diet and activity level based on energy requirements, and suggest improvements.
    4.7 Deduce that diets geared to weight reduction are most effective when a major lifestyle change is implemented and a lasting balance of food intake and activity results.

SUGGESTED OPTIONAL UNIT: GEOLOGY

Overview

Several theories have been used to explain the existence of geological forces such as volcanoes and earthquakes. Students will examine evidence and determine how well the current theory and model explain such evidence. Activities should promote the students' understanding of the important role technologies, such as remote sensing and Richter scale determinations, play in the collection of relevant data.

Attitudes

Students will be encouraged to:

- recognize that scientific knowledge is cumulative and subject to change
- appreciate the limits of science and technology in problem solving
- appreciate the ethical dilemmas that may arise from the application of scientific research and/or technological developments
- appreciate that proposed theories such as "plate tectonics" may be supported or refuted by experimental results
- appreciate the relationship between science and technology in the area of geology
- appreciate the beauty/magnitude of the earth's geological features and processes.

Skills

Students will be expected to demonstrate an ability to:

- apply data collection, organization and interpretation skills
- identify trends in data, and make predictions from those trends
- use established scientific models as a comparative base for observable data
- identify components and interactions within geological systems
- use precise terminology and symbols.

Concepts

1. *Students will be expected to* demonstrate an understanding that movements of the earth's crust result in earthquakes, volcanoes and mountain building.

    1.1 Describe theories that explain dynamic changes occurring in the earth's crust.
    1.2 Illustrate, using at least one example, that movement of the earth's crust is localized.
    1.3 Identify the current theory explaining the earth's internal structure.
    1.4 Assess evidence on the current theory of the internal structure of the earth.

2. *Students will be expected to* demonstrate an understanding that the forces of nature can be explained by the movement of water, air and land.

    2.1 Assess why movement requires an energy source.
    2.2 Describe how forces cause specific patterns of movement of water, air and land.
    2.3 Investigate and describe how movement of water, air and land can alter the surface of the earth.

3. *Students will be expected to* demonstrate an understanding that technology can be used to predict the forces of nature.

    3.1 Assess the limitations of modern technology in measuring and accurately predicting the earth's movement, using one example.
    3.2 Explain why the earth's movement can be measured, but not accurately predicted, even with modern technology.
    3.3 Describe how the technology involved in predicting the forces of nature is developing rapidly.
    3.4 Examine and describe a rapidly developing technology associated with predictions of the forces of nature.

4. *Students will be expected to* demonstrate an understanding that theories may be updated based on new evidence.

    4.1 Describe the historical development of a current theory that offers an explanation for a geological feature and/or process.
    4.2 Explain how the accumulation of data contributes to evidence that may support, modify or refute a theory explaining a geological feature and/or process.

SUGGESTED OPTIONAL UNIT: WEATHER

Overview

Present-day theories and models of the earth's atmosphere attempt to explain weather phenomena such as hurricanes, tornadoes, violent storms and general weather patterns. Students will examine the evidence, and determine how well the theory and model explain such evidence. The contribution of technological data-gathering techniques and devices, such as weather satellites, will be considered.

Attitudes

Students will be encouraged to:

- recognize that scientific knowledge is cumulative and subject to change
- identify the limits of science and technology in problem solving
- appreciate the ethical dilemmas that may arise from the application of scientific research and/or technological developments
- appreciate that proposed theories attempting to explain weather phenomena may be supported or refuted by experimental results
- appreciate the relationship between science and technology, as related to the explanation and prediction of weather phenomena
- appreciate the power and magnitude of weather phenomena.

Skills

Students will be expected to demonstrate an ability to:

- apply data collection, organization and interpretation skills
- identify trends in data, and make predictions from those trends
- use established scientific models as a comparative base for observable data
- use precise terminology and symbols.

Concepts

1. *Students will be expected to* demonstrate an understanding that the earth's atmosphere can be monitored for temperature, pressure and speed.

    1.1 Relate weather patterns to the constant flux of the earth's atmosphere.
    1.2 Identify and use technology associated with measuring various characteristics of air masses.
    1.3 Investigate various weather patterns and their impact on the earth's surface.

2. *Students will be expected to* demonstrate an understanding that weather can be explained by the movement of water and air.

    2.1 Describe why movement requires an energy source.
    2.2 Identify and describe the energy sources and energy conversions involved in such movements.
    2.3 Describe how forces cause specific patterns of movement of air and water.

3. *Students will be expected to* demonstrate an understanding that technology can be used to predict the forces of nature.

    3.1 Describe how weather can be predicted, and discuss why forecasts are accurate and inaccurate.
    3.2 Describe how technology plays a key role in weather forecasting.
    3.3 Describe how the technology involved in predicting the weather is developing rapidly.
    3.4 Identify and describe a rapidly developing technology associated with prediction of weather.

4. *Students will be expected to* demonstrate an understanding that theories may be updated based on new data.

    4.1 Describe the historical development of a present-day theory that offers an explanation of a weather-related force of nature; e.g., tornado formation.
    4.2 Explain how the accumulation of data may support, or refute, a theory that explains a weather phenomenon.

SECOND LANGUAGES

CONTENTS

French as a Second Language (ECS to Grade 12)

German 10–20–30

★ Italian Language and Culture 10–20–30

Japanese Language and Culture 10–20–30

Latin 10–20–30

★ Spanish Language and Culture 10–20–30

Ukrainian
- Three-year Program — Ukrainian 10–20–30
- Six-year Program — Ukrainian 10S–20S–30S

★ This interim program was provincially implemented in September 1997. Copies of the interim program of studies are available for viewing and downloading from the Alberta Education web site.

FRENCH AS A SECOND LANGUAGE

A. PROGRAM RATIONALE AND PHILOSOPHY

INTRODUCTION

In Alberta, "French as a second language" refers to courses in which the French language is taught as a subject, often between 20 to 40 minutes a day, to enable students to develop communication skills, cultural understanding and second language learning strategies in French. French as a second language is usually offered on an optional basis, although several school jurisdictions have chosen, in consultation with their communities, to offer French as a second language to all students, particularly at the elementary and junior high school levels.

In the 1960s and 70s, the French as a second language program stressed linguistic competence; that is, the knowledge of rules governing the language system. In the 1980s, the French as a second language program began to place more emphasis on communication skills, with a focus on language functions. In the 1990s, the program will emphasize the importance of experiencing language in context. Students' background knowledge, skills and attitudes will be used as a means of developing communicative abilities: interpreting, expressing and negotiating meaning through oral and written texts. In this perspective, culture is an inherent part of language. As students develop communication skills, they also increase their linguistic accuracy and develop language learning strategies. Elements from the experience/communication, culture, language and general language education components are integrated along a continuum of clearly defined levels of communicative growth.

French as a second language programs have been revised to make them more effective and current. The program consists of three well-defined levels of competency: **Beginning** (**Débutant**), **Intermediate** (**Intermédiaire**) and **Advanced** (**Avancé**), with each level being divided into three sublevels: **Beginning** 1, 2, 3; **Intermediate** 4, 5, 6; and **Advanced** 7, 8, 9. Each level specifies learner expectations for students in these areas: fields of experience and communication, cultural knowledge and understanding, use and understanding of the language system (sound–symbol system, vocabulary, grammar and discourse), and knowledge and application of strategies for learning languages. The program incorporates current knowledge about second language acquisition and curriculum design. It enhances the language development of students along a continuum of communicative growth. Finally, the program maintains present local flexibility so that school boards may offer French as a second language at different grade levels, depending on community aspirations and available financial and human resources. It is important that teachers have a sufficient level of language proficiency in French and training in second language methodology.

The **Beginning**, **Intermediate** and **Advanced** levels represent the essential knowledge, skills and attitudes in three stages of second language

development, based on actual classroom experience as judged by practicing educators in Alberta. The learner expectations range from the most minimal level of second language competence to an advanced level.

Communication skills evolve from simple messages of at least two or three statements at the **Beginning** level to a series of coherent ideas at the **Advanced** level. The development of cultural understanding proceeds from identification to research to analysis to interpretation of cultural knowledge. Linguistic development will include more emphasis on pronunciation and orthography at the **Beginning** level, with increasing importance given to grammatical complexity and correctness and use of discourse elements at the **Intermediate** and **Advanced** levels. General language education focuses on the progressive development of simple to more complex uses of processes in the cognitive, socio-affective and metacognitive domains.

Each major level includes three sublevels that are intended to reflect a degree of development within each level. The increasing complexity of communication skills, cultural knowledge, linguistic competence and general language education differentiates the sublevels.

RATIONALE

Learning French as a second language will enable students to develop the knowledge, skills and attitudes they need to communicate in French in a variety of school, travel, leisure and job-related contexts. Being able to use the French language is an important aspect of Canadian life. As well, French is the language of daily communication in many other countries.

Students should learn to recognize and respect the cultural diversity in our society. In this regard, the French as a second language programs will extend the cultural experience of students. It will enable them to better understand and interpret francophone cultures in Canada and in other countries of the world.

Developing thinking skills and learning strategies is an important part of lifelong learning. Students who learn French will enhance their language skills in general and develop an understanding of the nature and role of language and culture in their lives. They will acquire second language learning strategies that will enable them to monitor, direct and transfer their language learning to new life situations.

Adding a second language to their repertoire of skills and knowledge indirectly will help students enhance their first language development. Students will acquire the academic, intellectual and personal benefits that come from learning an additional language.

PHILOSOPHY

In the French as a second language program students will acquire various kinds of knowledge, skills and attitudes about:

- interpreting, expressing and negotiating meaning (communication)
- patterns of ideas, behaviours, manifestations, cultural artifacts and symbols shared by francophone peoples (culture)
- sounds, written symbols, vocabulary, grammar and discourse (language)
- cognitive, socio-affective and metacognitive processes (general language education). This multidimensional approach reflects current knowledge about second language learning and teaching.

Students will learn French as a second language by interacting with their own environment and using their already-acquired knowledge, attitudes and behaviours; that is, their personal experiences or "fields of experience", often first lived in their mother tongue. Fields of experience systematically reflect the different dimensions of an individual's relationship with the environment: the physical dimension, the social dimension, the civic dimension, the intellectual dimension and the dimension of leisure. The physical dimension consists of fields of experience such as nutrition, physical exercise, self-protection and personal hygiene — fields of experience related to the survival of individuals and to their physical well-being. The social dimension includes fields of experience related to family, school, friends, work, holidays and celebrations, and social activities. The civic

dimension includes fields of experience that are related to life in society, particularly from the point of view of an individual's privileges and responsibilities, such as conservation and consumerism. The intellectual dimension includes the fields of experience associated with the activities of the mind, such as the arts and sciences. The leisure dimension includes the experiences that relate to the activities of individuals during their free time, such as outdoor living, travel, and clubs and associations. The fields of experience provide the contexts for developing the communication, culture, language and general language education components.

Students will learn to communicate in French through the processes of "comprehension", "production" and "negotiation". Comprehension involves deriving meaning or significance from an oral or written text. Production is expressing meaning by creating oral and written texts to suit different participants, topics, purposes and reasons for communication. Negotiation is the interaction process: participants in the communication process must adjust to the needs and intentions of others. Integral to all three processes are the communicative intents or functions of communication, such as asking for or receiving information, reporting or describing and so on, which are developed in the experience/communication component.

In French as a second language, students will also learn about culture; the ideas, behaviours, manifestations, cultural artifacts and symbols shared by francophone peoples in different environments at different periods of their evolution or history. Specifically, students will acquire knowledge about the contemporary presence of francophones, their history, daily activities and language variations. Students will learn about local and provincial francophone cultures and about francophones in Canada and other countries of the world.

Students will also learn about, and how to use, the language: the sound–symbol system, vocabulary, grammar and discourse elements that are needed to convey ideas and enhance communication in an oral or written context.

The general language education component of the French as a second language program involves the development of cognitive, socio-affective and metacognitive processes. The cognitive dimension is developed through strategies such as making associations between words, identifying key words and ideas, reasoning both deductively and inductively, and using linguistic clues. The socio-affective dimension is developed through strategies such as taking risks, asking for clarification and becoming aware of others' thoughts and feelings. Metacognitive processes are developed through strategies such as concentrating on a task, planning a learning experience or monitoring one's own learning. These strategies together facilitate awareness of the learning process and its application to learning a second language. An added benefit is the conscious realization that these processes, used in one's first language, can enhance second language learning as well.

The four components (experience/ communication, culture, language, general language education) are integrated, but each has a different focus and emphasis. The experience/communication component fosters language experience in order to interpret and express meaning, with negotiation as the vehicle. The culture component focuses on features of the ideas, experiences, manifestations, behaviours and symbols that are representative of francophone cultures locally, nationally and internationally at different periods of their evolution or history. The language component identifies the linguistic elements needed to communicate in a specific context. The general language education component develops thinking skills and the specific actions or techniques that learners can use to learn a second language.

Students acquire this multidimensional set of knowledge, skills and attitudes along a progression or continuum. Language learning is a gradual, developmental process. During this learning process, knowledge, skills and attitudes are growing concurrently, at different rates and degrees of development. The continuum in this program of studies is identified as **Beginning**, **Intermediate** and **Advanced** levels. The levels, characterized by cyclical overlap and refinement, represent expanding access to French as a second language through nine sublevels.

DEFINITIONS OF LEARNER EXPECTATIONS

The learner expectations represent the minimum knowledge, skill and attitude outcomes that students are to attain. These expectations emphasize abilities to interpret, express and negotiate meaning through spoken and written texts — abilities that are closely related to the actual use of French throughout life. The organization of learner expectations is cyclical so that students can continue to refine skills and knowledge in an increasingly more varied manner throughout the program.

The learner expectations of the French as a second language program are divided into three parts: **global, general** and **specific**. The program sequence consists of three levels: **Beginning, Intermediate, Advanced,** and nine sublevels: **Beginning** 1, 2, 3, **Intermediate** 4, 5, 6 and **Advanced** 7, 8, 9. The global learner expectations pertain to the program, the general learner expectations to the levels and the specific learner expectations to the sublevels.

The **global** learner expectations reflect the knowledge, skills and attitudes targeted for the program as a whole and are based on the principles of the four components of a multidimensional curriculum: experience/ communication, culture, language and general language education.

The **general** learner expectations describe learner expectations at the end of the **Beginning** level and specify the extent to which the learner will achieve the global expectations in the four components.

The **specific** learner expectations describe the relative level of achievement expected of learners at the end of each sublevel in the four program components at the **Beginning** level. The specific learner expectations for language, for example, indicate the sublevel at which linguistic elements are introduced, developed and refined. The general sequence is to introduce linguistic elements at one sublevel, develop them in the second and refine these elements in the third sublevel. Further refinement of learning will continue throughout students' learning. The entire teaching/learning process must ensure the development, refinement and continual recycling of knowledge and skills, both concrete and abstract, as students progress towards the attainment of the global learner expectations.

The three types of learner expectations, from **global** to **general** to **specific**, demonstrate increasing levels of specificity with the **specific** learner expectations providing the basis for classroom instructional planning.

Each level and sublevel prescribes a minimum number of fields of experience, i.e., those aspects of reality about which the individual has already developed certain knowledge, patterns of behaviour and attitudes. Practicing educators judged these fields of experience to be suitable and adaptable for the different age groups taking the **Beginning** level. These fields of experience are in sequence, from the more concrete to the more abstract, and they build on and integrate the fields prescribed at previous levels and sublevels.

A minimum number of fields of experience is prescribed at the **Beginning** level. The recommended sequence of these fields of experience within the sublevels can be varied according to students' interests, teachers' interests and expertise, and learning resources available. Instruction should address all of the prescribed fields of experience by the end of each level. Teachers are encouraged to select additional fields of experience to enhance their program on the basis of students' interests and needs.

The French as a second language program proposes a balance between non-analytical and analytical learning. The focus of non-analytical learning is communication of the message through interaction without in-depth study of linguistic elements. Non-analytical learning is an important foundation for developing communication skills in French in the experience/communication component. In analytical learning, students develop explicit knowledge and understanding of the culture, language and general language education components.

Given the integration among components, however, the degree of emphasis on analytical or non-analytical aspects will vary. Both aspects of second language teaching/learning will always be present. What will change, however, is the focus or emphasis within a specific component.

B. GLOBAL AND GENERAL LEARNER EXPECTATIONS

BEGINNING LEVEL

Global Learner Expectations	General Learner Expectations
Based on their life experiences, *learners will be able to*:	Based on their life experiences, *learners will be able to*, depending on the field of experience:
Experience/ . . . participate in various language experiences that will enable them to . . .	• engage in language experiences dealing with: **Beginning 1** School People around us Weather Animals Holidays and celebrations **Beginning 2** Community Clothing Exercise Food Housing **Beginning 3** Activities Vacations Fine arts Trades and professions Hygiene and safety and other fields that relate to their needs and interests
Communication . . . express, in French, their experiences, ideas and feelings and understand those of other learners while interacting with interlocutors in various situations . . .	• understand a series of simple oral and written statements in a given controlled or structured context • express their communicative intent by producing simple oral and written messages of at least two or three statements in a given controlled or structured context
Culture . . . seek information on and understand different aspects of francophone cultures in Canada and elsewhere with a view to broadening their awareness of such cultures and more effectively interpreting them . . .	• identify the presence of francophone individuals and groups and concrete facts about francophone culture at the local, provincial, regional and national levels
Language . . . understand and use the linguistic code, which encompasses the sound–symbol system, vocabulary, grammar and discourse features, to fulfill their communicative intents in various situations . . .	• understand and use, orally and in writing, the sound–symbol system, vocabulary and word order in simple communications in the present tense

Global Learner Expectations	General Learner Expectations
General Language Education . . . be aware of the nature of learning and its role in individual cognitive, socio-affective and meta-cognitive development.	• identify key words in a communication to develop tolerance of ambiguity (cognitive) • discover the language by establishing associations between words (cognitive) • develop the positive attitude of taking risks by voluntarily using their knowledge (socio-affective) • develop the ability to use selective attention (metacognitive).

INTERMEDIATE LEVEL

Global Learner Expectations	General Learner Expectations
Based on their life experiences, *learners will be able to*:	Based on their life experiences, *learners will be able to*, depending on the field of experience:
Experience/ . . . participate in various language experiences that will enable them to . . .	• engage in language experiences dealing with: **Intermediate 4** Health and exercise Holidays and celebrations Clubs and associations Shopping Senses and feelings **Intermediate 5** Close friends Fashion Social life Outdoor activities Advertising **Intermediate 6** World of work Trips, excursions or student exchanges Money Role of the media Conservation and the environment and other fields that relate to their needs and interests
Communication . . . express, in French, their experiences, ideas and feelings and understand those of other learners while interacting with interlocutors in various situations . . .	• understand the meaning of an oral or written text on familiar topics in mainly structured situations, in addition to some unstructured situations • express their communicative intent based on the communicative task, orally and in writing, by producing a series of connecting ideas, usually prepared in advance and, on occasion, spontaneously
Culture . . . seek information on and understand different aspects of francophone cultures in Canada and elsewhere with a view to broadening their awareness of such cultures and more effectively interpreting them . . .	• describe some facets of francophone cultures by identifying and researching the similarities and differences between the culture of their community and francophone cultures at local, provincial, regional, national and international levels
Language . . . understand and use the linguistic code, which encompasses the sound–symbol system, vocabulary, grammar and discourse features, to fulfill their communicative intents in various situations . . .	• understand and use the sound–symbol system, vocabulary, and word and sentence order in simple and complex oral and written communications, especially in the present and future tenses, and occasionally in the past tense

Global Learner Expectations	General Learner Expectations
General Language Education . . . be aware of the nature of learning and its role in individual cognitive, socio-affective and metacognitive development.	• identify the main message in a communication to develop tolerance of ambiguity (cognitive) • discover the language by using nonverbal clues or other aids extraneous to the text (dictionaries, graphs, illustrations) to assist in the comprehension or production of a communication (cognitive) • take risks by accepting that mistakes are a part of language learning (socio-affective) • develop an individual learning plan regarding a particular task (metacognitive).

C. SPECIFIC LEARNER EXPECTATIONS

BEGINNING LEVEL

Component	Beginning 1	Beginning 2	Beginning 3
	Based on their life experiences, *learners will be able to*, depending on the field of experience:		
Experience/	• engage in various language experiences in the following fields: – **school** – **people around us** – **weather** – **animals** – **holidays and celebrations**	• engage in various language experiences in the following fields: – **community** – **clothing** – **exercise** – **food** – **housing**	• engage in various language experiences in the following fields: – **activities** – **vacations** – **fine arts** – **trades and professions** – **hygiene and safety**
	and other fields that relate to their needs and interests ----------		
Communication	• understand the meaning of a series of simple oral statements containing basic vocabulary and commonly used sentences	• understand the meaning of a series of simple oral or written statements using basic vocabulary and commonly used sentences	• understand the meaning of variations of simple oral or written statements and commonly used sentences
	• express their communicative intent by orally producing simple and/or commonly used messages containing one or two statements in a structured context	• express their communicative intent by producing, orally and in writing, simple and/or commonly used messages containing one or two statements in a structured context	• express their communicative intent by producing, orally and in writing, simple messages by recombining two or three statements in a structured context
Culture	• identify concrete facts that reveal the presence of francophone individuals and groups in their immediate surroundings	• identify concrete facts that reveal the presence of francophone individuals and groups at the local, provincial and regional levels	• identify concrete facts that reveal the presence of francophone individuals and groups at the provincial, regional and national levels
Language	• understand the sound–symbol system and vocabulary appropriate to simple oral messages in the present tense	• understand the sound–symbol system, vocabulary and word order appropriate to simple oral or written messages in the present tense	• understand the sound–symbol system, vocabulary and variations in word order appropriate to simple oral or written messages in the present tense
	• use, orally, the sound–symbol system related to vocabulary appropriate to the field of experience in the present tense, employing the following linguistic elements:	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, while respecting word order in the present tense and using the following linguistic elements:	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, while respecting word order in the present tense and using the following linguistic elements:

	Beginning 1	Beginning 2	Beginning 3
Language (continued)	**INTRODUCTION**	**DEVELOPMENT**	**REFINEMENT**
	• gender • the plural of nouns • definite and indefinite articles • verbs such as **avoir**, **être**, **faire** and **aller** in the present tense, using the appropriate personal pronoun • negative and affirmative sentences • expressions with **avoir** and **faire** (**J'ai dix ans. Il fait froid.**) • prepositions of place • commonly used sentences • cohesive elements at the word level (word connectors) • commonly asked questions		
		INTRODUCTION	**DEVELOPMENT**
		• qualifying adjectives • the imperative form (singular) • possessive adjectives (**mon, ma, mes, ton, ta, tes, son, sa, ses**) • -ER verbs in the present tense, using the appropriate personal pronoun • the questions: **qu'est-ce que...?, qui...?, quand est-ce que...?, où est-ce que...?, quel...?** • the partitive	
			INTRODUCTION
			• **vouloir**, **pouvoir** and **devoir** in the present tense, using the appropriate personal pronoun • the questions: **comment est-ce que...?, combien est-ce que...?, and pourquoi est-ce que...?** • **-IR** and **-RE** verbs in the present tense, using the appropriate personal pronoun • possessive adjectives (**notre, nos, votre, vos, leur, leurs**) • the immediate future, using the appropriate personal pronoun • the imperative form (all forms) • the pronominal form (e.g., **Je me lève**)

Component	Beginning 1	Beginning 2	Beginning 3
General Language Education	• identify cognates in oral communications (cognitive)	• identify the meaning of words by their roots in oral and written communications (cognitive)	• identify the meaning of phrases using the context (cognitive)
	• associate gestures or illustrations with words, orally (cognitive)	• identify related words, orally and in writing (cognitive)	• identify word families, orally and in writing (cognitive)
	• articulate, voluntarily, statements that are presented (socio-affective)	• respond voluntarily to a statement or to aspects of non-verbal communication (socio-affective)	• create, voluntarily, statements using words and commonly used sentences (socio-affective)
	• identify, orally, with the teacher's assistance, key words needed to follow directions concerning a task (metacognitive).	• identify, orally and in writing, with the teacher's assistance, key words needed to follow directions concern-ing a task (metacognitive).	• identify, orally and in writing, without teacher assistance, key words needed to follow directions concerning a task (metacognitive).

INTERMEDIATE LEVEL

Component	Intermediate 4	Intermediate 5	Intermediate 6
	Based on their life experiences, *learners will be able to*, depending on the field of experience:		
Experience/	• engage in various language experiences in the following fields: - **health and exercise** - **holidays and celebrations** - **clubs and associations** - **shopping** - **senses and feelings**	• engage in various language experiences in the following fields: - **close friends** - **fashion** - **social life** - **outdoor activities** - **advertising**	• engage in various language experiences in the following fields: - **world of work** - **trips, excursions or student exchanges** - **money** - **role of the media** - **conservation and the environment**
	and other fields that relate to their needs and interests ----------		
Communication	• understand the meaning of a series of interrelated ideas in oral or written texts dealing with a familiar topic in mainly structured situations, in addition to some unstructured situations	• understand the meaning of a fairly long series of interrelated ideas in oral or written sentences dealing with a familiar topic in both structured and unstructured situations	• understand the meaning of an oral or written text containing simple and complex ideas dealing with a variety of familiar topics in both structured and unstructured situations
	• express their communicative intent based on the communicative task, by producing, orally and in writing, a series of interrelated ideas, mostly prepared but sometimes spontaneously	• express their communicative intent based on the communicative task, by producing, orally and in writing, a series of interrelated ideas, mostly prepared but sometimes spontaneously	• express their communicative intent based on the communicative task, by producing, orally and in writing, a prepared or spontaneous series of interrelated ideas
Culture	• research and identify the similarities and differences between the culture of their community and francophone cultures at the local, provincial, regional or national levels	• research and identify the similarities and differences between their own culture and francophone cultures at the national and international levels	• research and identify similarities and differences between their own culture and international francophone cultures

Component	Intermediate 4	Intermediate 5	Intermediate 6
Language	• understand the sound–symbol system, vocabulary and word order appropriate to simple oral or written texts in the present and future tenses	• understand the sound–symbol system, vocabulary and sentence order appropriate to simple oral or written texts in the present, future and past tenses	• understand the sound–symbol system, vocabulary and sentence order appropriate to simple and complex oral or written texts in the present, future and past tenses
	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, employing simple and complex sentences, especially in the present tense, occasionally in the future tense, and use the following linguistic elements:	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, employing simple and complex sentences, especially in the present and the future tense, occasionally in the past tense, and use the following linguistic elements:	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, employing simple and complex sentences, especially in the present and the future tense, occasionally in the past tense, and use the following linguistic elements:
	INTRODUCTION • the comparative • expressions with the verb **faire** • questions using inversion • adverbs and adverbial expressions • emphatic pronouns • cohesive elements at the sentence level	**DEVELOPMENT**	**REFINEMENT**
		INTRODUCTION • the superlative • direct object pronoun (with present tense verbs) • indirect object pronoun (with present tense verbs) • the **passé composé**/the **imparfait** (without necessarily discriminating between passé composé and imparfait usages)	**DEVELOPMENT**
			INTRODUCTION • the simple future • the pronouns y and en, and the direct and indirect object pronouns as used in authentic discourse • the direct object (in the tense used) • the indirect object (in the tense used) • all interrogative pronouns • the present conditional

Component	Intermediate 4	Intermediate 5	Intermediate 6
General Language Education	• determine the meaning of key words (subject, action) in a communication (cognitive)	• formulate hypotheses about key points (cognitive)	• formulate hypotheses about communicative intents (cognitive)
	• use illustrations or nonverbal clues to facilitate understanding of a communication (cognitive)	• use a dictionary to find the meanings of words (cognitive)	• develop and use their own reference materials (cognitive)
	• accept that errors are a normal part of learning (socio-affective)	• correct, willingly, errors pointed out by someone else (socio-affective)	• correct their own errors when they are aware of them (socio-affective)
	• identify individual needs with respect to the task at hand by defining the problem and establishing objectives (metacognitive).	• select strategies among various choices appropriate to the task at hand, using questioning as a basis for individual learning (metacognitive).	• evaluate the execution of the learning plan (metacognitive).

BEGINNING LEVEL: SENIOR HIGH SCHOOL COURSES

Component	Beginning 1/2 [French 13]	Beginning 2/3 [French 10]
	Based on their life experiences, *learners will be able to*, depending on the field of experience:	
Experience/	• engage in various language experiences in the following fields: - **school** - **people around us** - **weather** - **holidays and celebrations** - **food** - **clothing**	• engage in various language experiences in the following fields: - **community** - **exercise** - **housing** - **activities** - **vacations** - **fine arts** - **trades and professions** - **hygiene and safety**
	and other fields that relate to their needs and interests	
Communication	• understand the meaning of a series of simple oral or written statements using basic vocabulary and commonly used sentences	• understand, orally and in writing, the meaning of variations of simple oral or written statements and commonly used sentences
	• express their communicative intent by producing, orally and in writing, simple and/or commonly used messages containing one or two statements in a structured context	• express their communicative intent by producing, orally and in writing, simple messages by recombining two or three statements in a structured context
Culture	• identify concrete facts that reveal the presence of francophone individuals and groups at the local, provincial and regional levels	• identify concrete facts that reveal the presence of francophone individuals and groups at the provincial, regional and national levels
Language	• understand the sound–symbol system, vocabulary and word order appropriate to simple oral or written messages in the present tense	• understand the sound–symbol system, vocabulary and variations in word order appropriate to simple oral or written messages in the present tense
	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience while respecting word order in the present tense and using the following linguistic elements: - gender - the plural of nouns - definite and indefinite articles - verbs such as **avoir**, **être**, **faire** and **aller** in the present tense, using the appropriate personal pronoun - negative and affirmative sentences - expressions with **avoir** and **faire** (**J'ai dix ans. Il fait froid.**) - prepositions of place - commonly used sentences	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, while respecting word order in the present tense and using the following linguistic elements: - imperative - **vouloir**, **pouvoir** and **devoir** in the present tense, using the appropriate personal pronoun - the questions: **comment est-ce que...?**, **combien est-ce que...?**, and **pourquoi est-ce que...?** - -IR and -RE verbs in the present tense, using the appropriate personal pronoun - possessive adjectives (**notre**, **nos**, **votre**, **vos**, **leur**, **leurs**)

Component	Beginning 1/2 [French 13]	Beginning 2/3 [French 10]
Language (continued)	- cohesive elements at the word level (word connectors such as and, because. . .) - commonly asked questions - qualifying adjectives - possessive adjectives (**mon, ma, mes, ton, ta, tes, son, sa, ses**) - -ER verbs in the present tense, using the appropriate personal pronoun - the questions: **qu'est-ce que...?, qui...?, quand est-ce que...?, où est-ce que...?, quel...?** - the partitive	- the immediate future using the appropriate personal pronoun - the pronominal form (e.g., **Je me lève**)
General Language Education	• identify known words, cognates, or the meaning of words by their roots in oral and written communications (cognitive) • associate, orally and in writing, words or expressions to gestures or illustrations (cognitive) • articulate and respond voluntarily to a statement or to aspects of verbal or non-verbal communication (socio-affective) • identify, orally and in writing, with the teacher's assistance, key words needed to follow directions concerning a task (metacognitive).	• identify the meaning of phrases using the context (cognitive) • identify word families, orally and in writing (cognitive) • create, voluntarily, statements using words and commonly used sentences (socio-affective) • identify, orally and in writing, without teacher assistance, key words needed to follow directions concerning a task (metacognitive).

INTERMEDIATE LEVEL: SENIOR HIGH SCHOOL COURSES

Component	Intermediate 4/5 [French 20]	Intermediate 5/6 [French 30]
	Based on their life experiences, *learners will be able to*, depending on the field of experience:	
Experience/	• engage in various language experiences in the following fields: – **close friends** – **fashion** – **social life** – **outdoor activities** – **clubs and associations** – **shopping** – **senses and feelings** and other fields that relate to their needs and interests	• engage in various language experiences in the following fields: – **world of work** – **trips, excursions or student exchanges** – **money** – **role of the media** – **conservation and the environment**
Communication	• understand the meaning of a series of interrelated ideas in oral or written texts dealing with a familiar topic primarily in structured situations and to some extent in unstructured situations	• understand the meaning of a text containing simple and complex oral or written ideas dealing with a variety of familiar topics in both structured and unstructured situations
	• express their communicative intent by producing, orally and in writing, a series of interrelated ideas, mostly prepared in advance but sometimes spontaneously, based on the communicative task	• express their communicative intent by producing, orally and in writing, a prepared, or occasionally spontaneous, series of interrelated ideas based on a communicative task
Culture	• research and identify the similarities and differences between their own culture and francophone cultures at the provincial, regional and national, and to some extent international levels	• research and identify similarities and differences between their own culture and international francophone cultures
Language	• understand the sound–symbol system, vocabulary and sentence order appropriate to simple oral or written texts in the present, future and past tenses	• understand the sound–symbol system, vocabulary and sentence order appropriate to simple and complex oral or written texts in the present, future and past tenses
	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, employing simple and complex sentences, especially in the present and the future tenses, occasionally in the past tense, and the following linguistic elements: – the comparative and superlative – adverbs and adverbial expressions – expressions with the verb **faire** – questions using inversion – emphatic pronouns – cohesive elements at the sentence level – direct object pronoun (with present tense verbs)	• use, orally and in writing, the sound–symbol system related to vocabulary appropriate to the field of experience, employing simple and complex sentences, especially in the present and the future tenses, occasionally in the past tense, and the following linguistic elements: – the simple future – use of the **passé composé** and **imparfait** – the pronouns **y** and **en** and the direct and indirect object pronouns as used in authentic discourse – all interrogative pronouns – the present conditional

Component	Intermediate 4/5 [French 20]	Intermediate 5/6 [French 30]
Language (continued)	– indirect object pronoun (with present tense verbs) – the **passé composé/imparfait** (without necessarily discriminating between passé composé and imparfait usages)	
General Language Education	• formulate hypotheses about key points (cognitive) • use illustrations, nonverbal cues or a dictionary to facilitate their comprehension and use of words (cognitive) • accept that errors are a normal part of learning and correct them willingly when they are pointed out by someone else (socio-affective) • identify individual needs by defining the problem and selecting strategies, among various choices appropriate to the task at hand, as a means of organizing learning (metacognitive).	• formulate hypotheses about communicative intents (cognitive) • develop and use their own reference materials (cognitive) • correct their own errors when they are aware of them (socio-affective) • evaluate the execution of the learning plan (metacognitive).

GERMAN

The three-year program for German as a second language (German 10–20–30) is designed for school jurisdictions that offer only a minimal program at the senior high school level.

It presupposes that individual communication (for example, giving personal information or expressing a desire to do something) is best realized through the use of those linguistic structures and vocabulary items that are appropriate to the social context of a situation.

In such an approach, the grammar of a language is a means to an end; that is, communication rather than an end in itself. The selection of the structural features for cognitive understanding, practice and free usage is based on meaningful themes. This approach is in contrast to that used in traditional grammar-based resources which, although exhaustive and well organized in their presentation of structural features within a given lesson, often lack a direct relationship to actual language usage that would be apparent to the student. The communicative approach to learning and teaching a second language does not exclude the explicit and deliberate treatment of grammar, but subordinates it to the needs of a particular situation. While practising a particular language structure, a student would be thinking in terms of expressing an idea rather than in terms of learning an abstract grammatical form.

Ten basic categories of language use have been identified and are subdivided into 63 themes. Examples of their realization through language are given as "linguistic content".

The program includes:

1. program goals that reflect the Goals of Basic Education, together with a rationale to support the inclusion of German in a school program
2. general objectives that specify the minimum expectations by the end of German 30 for each language skill (listening, speaking, reading and writing) as well as for cultural understanding
3. specific theme and performance statements for each grade level
4. linguistic content within a given grade level
5. specification of core and elective components.

A. PHILOSOPHY AND RATIONALE

To avoid isolation, a country must provide, through its centres of education, opportunities for learning and teaching various second languages. Among the many existing languages and their respective cultures, the German heritage has always played a significant part in the Canadian mosaic.

German is the sixth most used language in the world. It is spoken by approximately 110 million people. Of these, 62 million live in the Federal Republic of Germany, 17 million in the German Democratic Republic, 7 million in Austria,

4 million in Switzerland and a substantial number in the Americas, in Australia and in South and East Africa. According to the Canadian Census of 1981, speakers of German form the fourth largest ethnic group in Canada and the second largest in Alberta. The Canadian student of German is learning a language used by thousands of Canadians, and opportunities exist to speak with people who use German for everyday communication. In Canada, several newspapers are published regularly in German; radio and television programs are broadcast in this language, and German movies are shown frequently in the larger urban centres.

The purposes for which a student may learn a second language can be grouped hierarchically according to one's needs regarding the self, family and society. Satisfaction of these needs on the individual level will have very positive effects at the societal level. An individual's needs may be identified with respect to:

Self

1. being able to communicate with native speakers in another country while travelling for business or pleasure

2. gaining insight into one's first language by acquiring a knowledge of the structure of a second language

3. satisfying one's curiosity about a foreign culture and its value system

4. becoming knowledgeable, as part of a general education, about people and institutions in other cultures, thereby gaining better insights into one's own culture

5. developing an appreciation of works of art or other cultural contributions

6. fulfilling educational requirements, such as admission to university

7. enhancing one's career/job prospects: for example, providing translation services to business and government; in the tourist trade; in the export and import business; in advertising; the airlines; foreign service; immigration; social work and health services; in the media; in library work or publishing; in scientific and technical research; secretarial/executive skills; and in teaching at the elementary, secondary or post-secondary levels.

Family

1. communicating with members of one's family from the "old country"

2. understanding better one's family heritage in Canada, and preserving that heritage for future generations.

Society

1. being able to satisfy the requirements of various institutions of Canadian society, such as government, business and education

2. being able to contribute to a multicultural society that attempts to foster understanding among the peoples of the world.

B. GOALS AND OBJECTIVES

Goals determine the broad, long-range outcomes of a program.

Although the following goals may be given varying emphases, they are identified as those appropriate to learning German and are intended to enable the student:

1. to acquire basic communication skills in German by:

    1.1 developing the receptive skills of listening and reading, including an understanding of intonation, gestures and visual clues that help to convey a message

    1.2 developing the productive skills of speaking and writing, including the appropriate intonation, gestures and visual clues that help to convey a message fluently and accurately

2. to broaden personal perspectives, and to develop cultural sensitivity by:

   2.1 developing a greater awareness and appreciation of various cultural values and lifestyles

   2.2 becoming more aware of Canada's multicultural heritage through the study of German

   2.3 developing a positive attitude toward people who speak another language, through a variety of exposures to the German language and culture

   2.4 becoming aware of and appreciating, through instruction and direct experiences, the valuable contributions of German-speaking peoples to culture and civilization

   2.5 expanding them to include the national and international scene, through active participation in a language spoken by many Canadians

   2.6 beginning to acquire those skills needed to function and communicate within a German-speaking society

3. to develop originality and creativity in language by:

   3.1 facilitating the application of the language skills to new and meaningful situations

   3.2 facilitating the expression of personal ideas, feelings and attitudes

4. to acquire additional concepts and generalizations about language and language learning by:

   4.1 recognizing the basic structural similarities and differences between German and English

   4.2 acquiring some knowledge of the structure and function of languages

   4.3 developing an awareness of regional, social and functional variations of spoken and written language

   4.4 developing a conscious knowledge of the skills and strategies used in learning a second language

5. to develop a desire to extend or improve one's proficiency in languages through further study, whether for interest, post-secondary requirements or vocational needs.

Minimum Expectations for Skill Development and Cultural Understanding

The following minimum expectations for skill development and cultural understanding are considered to be part of the core, or mandatory, content.

Listening Comprehension

With the successful completion of this program, *the student will have developed the ability to*:

1. distinguish phonemic differences within the German sound system

2. distinguish German intonation and stress patterns

3. demonstrate an understanding of familiar questions, statements and instructions that incorporate the basic elements of the program as specified in the curriculum guide

4. demonstrate an understanding of new combinations of structures and vocabulary of the program

5. understand various speakers in structured situations

6. recognize specific information and ideas within a given context

7. understand information in material containing cognates and a limited number of unfamiliar lexical items by inferring meaning from the context.

Speaking

With the successful completion of this program, *the student will have developed the ability to*:

1. produce comprehensible German sounds, intonation, rhythm, stress and elision with reasonable accuracy
2. respond to cues that require the use of the basic linguistic elements of the program
3. produce meaningful utterances by recombining known elements
4. describe a familiar situation
5. relate a sequence of actions
6. ask for information
7. interview someone, using the basic elements of language
8. speak with prior preparation on a selected topic
9. participate in a simple conversation or discussion on a familiar topic
10. express some personal ideas, feelings and attitudes.

Reading

With the successful completion of this program, *the student will have developed the ability to*:

1. read familiar materials silently, with comprehension
2. read aloud, familiar materials and global expressions with comprehension, correct rhythm and pronunciation
3. read with comprehension, recombinations and rearrangements of familiar materials
4. read, for general meaning, material containing some unfamiliar cognates or vocabulary items
5. read for specific information and ideas
6. read for major ideas contained in a short text
7. read simple newspaper and magazine articles and/or stories, for pleasure.

Writing

With the successful completion of this program, *the student will have developed the ability to*:

1. produce meaningful combinations or variations of given elements
2. write, from dictation, sentences containing recombinations of learned written materials
3. write a guided composition
4. describe a familiar situation
5. relate a sequence of actions
6. summarize a passage heard or read
7. write a letter to a friend.

Cultural Understanding

With the successful completion of this program, *the student will demonstrate an understanding and appreciation of*:

1. German-speaking cultures in Canada, Germany and other countries
2. some differences and similarities between the learner's culture and the various German-speaking cultures
3. the significance of social conventions, simple gestures, facial expressions, intonation and stress used by a speaker to convey intentions, feelings and attitudes
4. the cultural connotations of familiar vocabulary and expressions.

C. CONTENT

Categories of Language Use

The objectives and content are selected on the basis of categories of language use. They are:

1. social conventions
2. identification of persons, animals and things
3. expressing actions
4. expressing location
5. expressing time
6. expressing possession
7. expressing manner and means
8. expressing modes of action
9. expressing emotions and attitudes
10. expressing cause and effect.

These language functions are considered to be the main categories of verbal communication. In the classroom, each of the above categories may be realized separately or in various combinations. Examples of expected verbal performances in themes and linguistic content are specified for each category.

Themes

The themes indicate the minimum social interactions in which the students should be able to communicate in German.

Linguistic Content

The linguistic content identifies the minimum language structures, sentence patterns and vocabulary that students are expected to acquire.

The categories of language use, themes and linguistic content for each grade level are not arranged in any prescribed sequence, although it is recommended that the specified objectives and content be covered by the end of each grade. It is expected that the content specified in the categories of language use, the skills described in the themes listed in the linguistic content, and minimum expectations be mastered by the end of German 30.

Suggested Vocabulary

The vocabulary list contains the items in the linguistic content of the *Three-year German 10–20–30 Program Curriculum Guide*, 1984, and other words that are expected to be acquired by students successfully completing this program.

Cultural Themes

Cultural themes and topics are presented to assist the student in the development of insights into the way of life of German-speaking peoples, as well as the acquisition of knowledge about their achievements and contributions to culture and civilization. Specific cultural topics are considered to be elective.

Core Components

In summary, the core components consist of:

1. the minimum expectations for skill development and cultural understanding
2. the skills and concepts identified in the themes contained in the curriculum guide
3. the linguistic content specified for the three-year program
4. the major cultural themes.

Elective Components

The elective components consist of:

1. the suggested basic vocabulary
2. specific topics related to major cultural themes
3. the suggested classroom expressions.

ITALIAN LANGUAGE AND CULTURE 10–20–30

★ This interim program was provincially implemented in September 1997. Copies of the interim program of studies are available for viewing and downloading from the Alberta Education web site.

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JAPANESE LANGUAGE AND CULTURE 10–20–30

A. RATIONALE AND PHILOSOPHY

> When asked which language was most important for doing business, one Japanese answered, "My customer's."[1]

Formal education undertakes to develop every person's abilities. The results of education include lifelong intellectual curiosity, an appreciation of human diversity, an understanding of tradition and the facility to deal with internal and external change.

Education is beneficial to society; it also helps each person to fulfill his or her individual aspirations.

However, education does not operate in isolation. As societies change, the world changes and so, too, must education. The world is a dynamic and interconnected place. Economies rise and fall. Societies prosper and fade, and social systems function in continually changing environments. Education is part of the system. It must respond, and sometimes lead, in a continually expanding knowledge base and increased social interaction across national, ethnic and cultural boundaries.

The provincial government has provided a vision for the future of education in Alberta wherein students receive the challenge, curriculum, resources and leadership required to step confidently into today's interactive world. The goal is to help each student reach his or her potential. Each will be provided with the tools to define and develop a productive and useful role in society—tools such as critical thinking, creativity and the insight to learn about oneself as one learns about others. The ultimate aim is citizens who succeed on domestic and international fronts, who display respect toward others, and who act appropriately at home and abroad. This knowledge and the associated skills, concepts and attitudes are derived from a broad-based curriculum that has its roots in the multicultural nature of our province, our country and the world.

This program was developed with the generous financial support of the Asia Pacific Foundation of Canada.

[1] J. P. Alston, *The Intelligent Businessman's Guide to Japan*, Tokyo, Japan: Charles E. Tuttle Co., 1990.

One of the vehicles on the road to good citizenship is language education. Multilingual ability enriches our cultural and intellectual lives and lets us appreciate the world's exciting diversity. The doors to social, cultural and economic life, and the doors to education itself open only with the key of language.

A major world change is the emergence of Japan as a new leader in trade, science, technology and investment. With its long and illustrious past, Japan is also the repository of a wealth of tradition in the arts, history, religion, sports and other cultural areas. Japan continues to make significant contributions to world culture. As a major economic power, Japan is also preparing to expand its role in world politics.

Alberta's interaction with Japan is increasing. Through tourism, trade, twinning arrangements and investment, our relationship with Japan will become more and more important to our economic and social well-being.

Thus, there is a growing need for Albertans to communicate and function in Japanese cultural settings as they compete and interact in a variety of travel, education, leisure, political and job-related contexts. Japanese Language and Culture 10–20–30 answers this need. The program integrates knowledge, skills and subject material from across the curriculum to give students the abilities and attitudes necessary to communicate in Japanese. It also provides the opportunity for children of Japanese-Canadians to explore their cultural heritage.

Increased trade and growing investment by Japan in Alberta mean that Japanese language and cultural knowledge have taken on new importance. *Since Japanese-speaking people have begun to play an important economic role in our province, the Japanese Language and Culture Program is a strategic link in Alberta's future development.*

Future leadership roles will be available to those who have a wide range of knowledge and skills related to Japan. The expanding importance of the Alberta–Japan relationship mandates making educational opportunities available. *The Japanese Language and Culture Program prepares students for the future.*

The first step toward understanding Japanese people and culture is language. Language is the key form of human communication and the major medium for transmitting knowledge within and among societies. Language ability is tied to cultural knowledge. Culture is like an iceberg. Most of it is hidden. Only a small percentage manifests itself in cultural artifacts. To gain an understanding of the rest, it is necessary to access the true touchstone—the people. This can only be done through language. *The Japanese Language and Culture Program builds a reservoir of knowledge about Japanese culture.*

Illiteracy and cultural ignorance act as barriers in all forms of social endeavour—economic, artistic and academic. Without language, misunderstandings are born. Without cultural sensitivity, misunderstandings grow—sometimes to embrace organizations and even nations. Increased knowledge of each other, and the ability to communicate, contributes to a safer and better world. By building communication bridges, people can resolve misunderstandings before they grow into national issues. *The Japanese Language and Culture Program lowers communication barriers and helps prevent misunderstandings.*

Today, domestic endeavours influence and are influenced by the world at large. As Japan's global role widens to include business, science, politics and social development, individuals need linguistic and cultural knowledge about Japan. Alberta–Japan joint ventures are an area of opportunity. Communicating with partners is as important as talking to customers or suppliers. *The Japanese Language and Culture Program will help to open new partnership opportunities for Albertans in all fields of endeavour.*

Today, individuals, companies, provinces and nations must compete as they exploit and export science and technology. To do this, linguistic and cultural knowledge are necessary. *The Japanese Language and Culture Program enhances our competitive edge at all levels.*

Japan is a leader in developing technology and has many fine institutes of higher learning. Increasingly, we will need access to both in order to take advantage of all learning opportunities offered in the arts, science and technology. *The Japanese Language and Culture Program opens up new learning opportunities.*

Increased interaction with and understanding of others enhances personal growth and self-actualization. Appreciating cultural etiquette and artistic expression outside our own traditions helps us to grow and develop. *The Japanese Language and Culture Program contributes to personal growth and satisfaction.*

Japanese Language and Culture 10–20–30 must be viewed in broader terms than just learning to "speak Japanese." It is the pavement that smoothes the road to Japanese cultural literacy—a road that also leads to increased trade, better international relations and enhanced academic, artistic and technological opportunities.

4/ Japanese Language and Culture 10–20–30 (Senior High)
(1995)

B. LEARNER EXPECTATIONS

PROGRAM ORGANIZATION

Japanese Language and Culture 10–20–30 is an outcomes-based program. The curriculum identifies what students are to learn and to know and describes what they are expected to be able to do as a result of the instruction they receive. It is organized into levels reflecting the progression of students' growth. It incorporates accountability: students, parents and the public are told what kind of learning is expected, and how well students have performed in terms of those expectations.

Five stages of development for the general learner expectations are designated in this program. Stage 3 is the basic standard for graduation. Stage 4 and Stage 5 are designed for students whose home language is Japanese and for all students who are able to proceed quickly because they have access to the language outside the classroom; for example, students who have lived in Japan. Within each stage, five levels are defined. General learner expectations are specified for each stage, and specific learner expectations are outlined for each level.

The learner expectations are defined in terms of Knowledge, Skills and Attitudes. The knowledge category includes knowledge of the language—language awareness and grammatical rules; knowledge of culture—cultural and sociocultural information and aspects of civilization; and, concepts—understanding to be developed through the study of cultural facts. Mastery of *kanji* characters (ideographic/pictographic script) for active use are listed in the language knowledge section in Level 5 of each stage.

The skills category also consists of three aspects:

- linguistic skills: language functions and other linguistic skills, such as pronunciation, intonation, and receptive and productive skills in oral and written forms
- sociocultural skills: the skills required to behave appropriately in various contexts
- cognitive skills: critical and creative thinking skills.

The Japanese Language and Culture 10–20–30 Program recognizes the importance of the affective and social domains in education. The program provides the learner with opportunities to enter another way of life, another mode of behaviour and another rationality. Through interaction with Japanese speakers, students will develop flexibility and sensitivity in their approach to a different culture. The attitudes students are expected to develop are related to the specified topics and are outlined for each level.

The holistic approach also provides students with opportunities to acquire autonomous language learning strategies.

GENERAL LEARNER EXPECTATIONS

Five stages of development for the *General Learner Expectations* are designated in this program. Stage 3 is the basic standard for graduation. Stage 4 and Stage 5 are designed for students whose home language is Japanese and for all students who are able to proceed quickly because they have access to the language outside the classroom; for example, students who have lived in Japan. Within each stage, five levels are defined. General learner expectations are specified for each stage, and specific learner expectations are outlined for each level.

	STAGE 1 Introduction to Japan	**STAGE 2** Japan Today
KNOWLEDGE • *Language*	*Students are able to* recognize the existence of different language groups in the world. They demonstrate an understanding that Japanese does not belong to the same language family as English, by identifying different forms of writing, different structures and word order, and different ways in which utterances are made.	*Students are able to*: • recognize the systematic nature of language and the importance of idiomatic expressions in the language • identify the ways in which languages borrow from each other and change continuously • distinguish polite and plain forms, written and spoken styles, and young people's language • identify the different language forms required for different contexts.
• *Culture*	*Students are able to* perceive similarities and differences between the cultures of Japan and Canada as they deal with the topics related to their immediate environment, such as personal identification, home, health (hygiene), food and drink, clothing, school and personal interests. *Students are able to* apply their knowledge for communication purposes in the real-life situations suggested in Level 5: My Japanese Counterpart: Hosting a Friend from Japan.	*Students are able to* describe the traditional features and modern lifestyles of Japanese people. They are aware of the diverse nature of human society. By using language, students exhibit knowledge of geography, history, social systems, fine arts, work/employment and of how Japanese values are transmitted from generation to generation.

STAGE 3 Japan and the World	STAGE 4 Japan Tomorrow	STAGE 5 Specialized Areas of Study: Career-oriented Streams/ Humanity Studies
Students are able to understand that language is a manifestation of culture and that successful interaction with people requires not only the language but also cultural understanding. They become aware of the relationship between linguistic forms and meaning—communicative goals/functions. The same function can be achieved by a simple expression or by a sequence of sophisticated sentences, and the same expression can fulfill a number of different functions or different meanings.	*Students are able to* develop an awareness of the role of language in human society. They recognize that Japanese has its own discourse strategies that are heavily determined by the values and beliefs of the people.	*Students are able to* continue working toward expanding and refining their knowledge of the language and their ability to use the language effectively. They engage in assignments that expand their interactive competence in different genres.
Students are able to identify the relationships between Japan and other nations, and Japan's contributions to the world in the following areas: • national treasures • economics and politics • science and technology • global relationships • values.	*Students are able to* generalize about facets of human society. The following topics provide learning opportunities: • current issues and problems of modern society • social change • global relationships in terms of the exchange of human resources, technology and knowledge • science and technology • the working world.	*Students are able to* enrich further their knowledge in a specialized area of study: either career-oriented studies or humanity studies. The career-oriented studies incorporate knowledge and concepts from career and technology studies.

	STAGE 1 Introduction to Japan	STAGE 2 Japan Today
• *Concepts*	*Students are able to* begin understanding that culture is embedded in the language, by identifying set, idiomatic, expressions and body language. Concept development includes: • family bonds (blood ties) • cleanliness • inside/outside (insiders versus outsiders) • youth lifestyles.	*Students are able to* demonstrate an understanding that all people have universal cultural traits, such as language, religion and philosophy. Students identify how culture influences one's way of life. Concept development includes: • social group strata • historical concepts • influence of geography on lifestyle • religious beliefs • work ethics • "groupism."
SKILLS • *Linguistic* **Note**: Linguistic functions are not necessarily achieved only in oral production.	*Students are able to* initiate and establish relationships in short and simple productions, in a highly structured language environment. Their production is limited to learned materials. Their ability to use the language is restricted to familiar/predictable/predicted situations. They are able to interact with others, using the following functions: • attracting someone's attention • greeting • introducing • inquiring about others • answering questions • expressing and reacting to gratitude • giving/reacting to compliments • describing possession • expressing presence/absence/ location • giving/obtaining information • making simple requests • discussing preferences/ likes/dislikes • extending/accepting an invitation • giving/following/responding to instructions • expressing interest • making arrangements • asking for permission (continued)	*Students are able to* sustain relationships with others, using a wider range of language. They are able to manage longer texts and switches of topic and speaker. The functions to be mastered are: • exchanging information • accepting/declining/deferring invitation • giving/accepting compliments • expressing emotions • making simple comparisons • asking opinions • expressing simple opinions • responding to opinions • persuading • confirming/admitting/denying/ defining • asking for/refusing permission • expressing the concepts of giving and receiving • asking for explanations • giving reasons • discussing • identifying/describing • making arrangements/finalizing and confirming arrangements • making/granting a request • suggesting • expressing needs • participating in interviews • negotiating to make decisions (continued)

STAGE 3 Japan and the World	STAGE 4 Japan Tomorrow	STAGE 5 Specialized Areas of Study: Career-oriented Streams/ Humanity Studies
Students are able to understand that: • cultural understanding and sensitivity are developed through communication at a personal, interpersonal and national level • scientific, economic, cultural, technological and political factors contribute to social change • economic and political systems within nations are interdependent and influential in many ways • culture is dynamic and complex.	*Students are able to* understand changes that are created in and by a technological society, and the potential impact of these changes on people and society.	General expectations will vary according to the specialized area each student chooses to study.
Students are able to communicate in Japanese with a reasonable degree of fluency in a wider range of situations. Some of the following functions are recycled with students, using increasingly sophisticated language structures. The functions to be mastered are: • exchanging information • describing • expressing knowledge/opinions • reporting • seeking confirmation • expressing warning • expressing suggestion/advice • reacting to suggestions • planning • expressing predictions • expressing possibility • making comparisons • agreeing/disagreeing • making decisions • responding/reacting to requests • reacting to praise • explaining/asking for evaluation • expressing sympathy/regret/ concern • explaining/asking for evaluation (continued)	*Students are able to* refine their interactive competence, developing and expanding their skills with, and knowledge of, linguistic structures. The functions to be mastered are: • analyzing/interpreting • expressing obligation • clarifying • expressing opinion • drawing conclusions • expressing probability/ improbability • making predictions • discussing pros and cons • hypothesizing • expressing reasons • punctuating/paragraphing. *Students are able to* apply techniques used in writing letters, summaries, narratives and descriptions. *Students are able to* use, approximately, 150 additional *kanji* characters beyond those mastered in Stage 3. More *kanji* characters could be introduced, according to each student's needs.	*Students are able to* perform all the functions from previous stages, as well as the skills necessary to achieve communication goals in their own area of interest. These skills include: taking notes, summarizing, writing reports and essays, discussing and presenting views in written and oral form, and effective reading. Students can demonstrate complex patterns of discourse and are able to use "repair strategies." *Kanji* characters to be learned will depend on each student's specific area of study.

	STAGE 1 Introduction to Japan	STAGE 2 Japan Today
Note: Some functions may be repeated, as different and more sophisticated structures can express the same function.	(continued) • purchasing goods and obtaining services • narrating/reporting • identifying/describing • explaining • offering food and drink • apologizing and responding to apology • agreeing/disagreeing • encouraging • expressing desire • taking leave • seeking information/clarification/ repetition • expressing lack of comprehension • asking how to say something in Japanese. *Students are able to* distinguish sound patterns, which are essential for communication. *Students are able to* read and write all *hiragana* symbols and 20 *kanji* characters. *Kanji* characters are presented in context. *Students are able to* recognize *katakana* of frequently used words.	(continued) • making telephone calls • expressing probability • expressing certainty/uncertainty • seeking information/rephrasing • expressing prohibition • expressing intention • taking leave in formal situations. *Students are able to* present information in a variety of ways, and to obtain information from various texts, spoken or written. They have mastery of *hiragana* and *katakana* and read and write an increased number of *kanji* characters. Mastery means that students are able to use receptive and productive skills with sufficient accuracy. Forty-two *kanji* characters are to be learned at this stage.
• *Sociocultural*	*Students are able to* demonstrate an ability to interact with others by exhibiting culturally appropriate behaviour at a basic level. They become aware of how to conduct interpersonal relationships in Japanese society, to: • bow appropriately • use the polite form of the language when speaking to seniors • use appropriate titles when addressing others • use certain set phrases at appropriate times; e.g., meal time, leaving someone's room/home.	*Students are able to* demonstrate awareness of formal/informal situations, the notion of seniority, various levels of speech, and male and female speech. They are able to respond appropriately in a variety of situations, such as giving and receiving. They demonstrate knowledge of the significance of gift-giving in Japan. They are able to use some *aizuchi*, back-channelling expressions, appropriately and spontaneously.

STAGE 3 Japan and the World	STAGE 4 Japan Tomorrow	STAGE 5 Specialized Areas of Study: Career-oriented Streams/ Humanity Studies
(continued) • expressing needs/preferences • expressing ability/inability • expressing obligation • expressing intentions • negotiating • defining • debating • rephrasing. *Students are able to* demonstrate awareness of the existence of honorific and humble forms, male/female speech, and plain forms used in casual speech and in certain written texts. They are able to use some honorific and humble forms appropriately. *Students are able to* make active use of the 40 *kanji* characters set for Stage 3.		
Students are able to exhibit their knowledge of: • when to use stylistic variations • when and how to use some honorifics and humble expressions. *Students are able to* demonstrate an awareness of some communication rules, and apply a few of them accordingly, through the process of expanding scope of sociocultural experiences.	*Students are able to* develop further, and fine tune, the previously stated sociocultural skills. They begin to understand the nuances involved. *Students are able to* apply sociocultural rules successfully in a wider range of contexts.	*Students are able to* apply the previously learned rules freely and spontaneously, and use their skills in a variety of contexts.

	STAGE 1 Introduction to Japan	STAGE 2 Japan Today
• *Cognitive*	*Students are able to*: • observe and identify relevant information in their immediate environment • make guesses/predictions • identify or search for ideas/information • organize ideas/information • associate information with past experiences • identify sequence and patterns.	*Students are able to*: • locate and obtain information and search for specific details • process and use information • decode and interpret signs • select and apply criteria for evaluation • verify data and criteria • search for meaningful patterns among concepts • capitalize on errors and failures • use different strategies for different purposes.
ATTITUDES	*Students are able to* demonstrate a positive disposition toward a new and different language, culture and people by actively involving themselves in the language learning environment. They are willing to take risks.	*Students are able to* explore ideas beyond what is presented. They consider different or opposing points of view and try to take a constructive approach when analyzing an issue. Students show willingness to adapt learning strategies.

STAGE 3 Japan and the World	STAGE 4 Japan Tomorrow	STAGE 5 Specialized Areas of Study: Career-oriented Streams/ Humanity Studies
Students are able to: • respond to challenging circumstances, and achieve their original/modified goals • process, analyze and evaluate information from a range of sources by examining evidence and assessing a variety of viewpoints • present information in a logical and coherent way • conduct meaningful communications.	*Students are able to* explore concepts and bodies of knowledge, and constructively question established ideas. *Students are able to* reorganize information, and evaluate and hypothesize, using collected data. *Students are able to* clarify issues, synthesize and exercise judgement on the basis of clear criteria.	*Students are able to* develop further their previously acquired skills. They expand concepts and gain new insights through higher level, cognitive operations.
Students are able to appreciate the multicultural nature of Canada and their own language and culture, by: • demonstrating sensitivity to a variety of viewpoints • accepting uncertainty, change and ambiguity • exhibiting intellectual curiosity.	*Students are able to* deepen their knowledge, and to search for a specific field of interest, by: • developing their creative abilities, and using them constructively • being willing to do everything they possibly can to learn effectively.	*Students are able to* pursue further knowledge and understanding.

SPECIFIC LEARNER EXPECTATIONS

Specific Learner Expectations are divided into five stages. Each stage has five levels, and a modular theme is identified for each level.

STAGE 1: INTRODUCTION TO JAPAN

	LEVEL 1 Self and Surroundings	**LEVEL 2** Basic Needs 1: Food, Dwellings, Clothing
KNOWLEDGE • *Language*	*Students are able to:* • recognize basic word order: in the normal *desu/masu* form, which is introduced at this level, verbs and copula *(desu)* are placed at the end of a sentence • recognize the *hiragana* and *katakana* of frequently used words • recognize that *kanji* have been imported and adapted to fit into the Japanese language, and that *hiragana* and *katakana* are phonetic symbols that gradually evolved from *kanji* • recognize that Japanese is written in a mixture of *kanji*, *hiragana* and *katakana* • acknowledge that *ka* is added at the end of a sentence, after the normal form, to make it into a question. The word order does not change as it does in English • use in-group/out-group family terms appropriately • exhibit the following grammatical knowledge in simple sentences: – *~ wa ~ desu/ja nai desu* [subject is/is not ~] – particles: • *to* (and) • *mo* (also) – common expressions related to self-introduction: • *~ ni sunde imasu* (I live at ~) • ~ kookoo *no* ~ *desu*, etc. (I am ~ of ~ school.) – basic numerals 1 to 100.	*Students are able to:* • recognize basic word order: adjectives are placed before nouns to modify, or before *desu*, copula in normal form • recognize all the *hiragana* in the *hiragana* table and understand already introduced words and structures written in *hiragana* • recognize some *kanji* characters related to the words introduced at this level • recognize *katakana* of frequently used words • recognize many set phrases used in daily life routines, such as when leaving home and coming home, when eating, when going to bed • recognize that languages borrow from each other and that Japanese borrowed many words from different countries, such as Portugal, England, France, Italy, and adapted them by changing the transcription and pronunciation • recognize that there are many counters and measure words for different kinds of objects • recognize that the most common syllables in Japanese are a combination of a consonant and a vowel, and each syllable is of relatively equal length • exhibit the following grammatical knowledge in their language use: – identify the existence of particles – verb + *masen ka* [to invite someone] – use of the particles: • *ni* versus *de* of location • *ya* (and) (continued)

LEVEL 3 Basic Needs 2: Shopping and Transport	**LEVEL 4** Students' Interests	**LEVEL 5** My Japanese Counterpart: Hosting a Friend from Japan
Students are able to: • recognize the language used in transactions to obtain goods and services • identify the functions of the particles introduced to date • use *kore*, *sore* and *are* appropriately in terms of spatial relations between object, speaker and listener: this which is near myself, that which is near yourself, that which is within our common view • recognize the combinations of two *hiragana* symbols that make a single sound: *ki, gi, shi, ji, chi, ni, hi, bi, pi, mi, ri* with small *ya, yu, yo* • recognize that Japanese can be written vertically and horizontally • exhibit the following grammatical knowledge in their language use: – TE form of verb – TE form of verb + *kudasai* [request] – TE form of verb + *mo ii desu ka* [asking for permission] – TA form of normal (*desu/masu*, *deshita/mashita*) form [past aspect] – normal OO form (~ *mashoo*) – use of the particles: • *to* (together with) • *ka* (or) • *ne* [requesting either confirmation or agreement from a listener] • *ni* (at) – *demo* (even) – ~ *o kudasai* (please give me ~) – basic numerals 100 to 10 000.	*Students are able to:* • identify the language used among young people: – some examples of the new words, intonation and accent • exhibit the following grammatical knowledge in their language use: – two types of stative predicates: adjectives ending in ~*i*, and adjectival nouns – two ways to use the adjectives: • adjective + noun [noun-modifying] • noun *wa* adjective *desu* [subject and stative predicate] – normal negative form of verbs with qualifiers *zenzen* ([not] at all) and *amari* ([not] too much) • *zenzen* ~ *masen* • *amari* ~ *masen* – normal form of verb to express future actions and habitual actions: TE form of verb to express successive actions – verb + *tai* form [desiderative] – use of the particle *no*: • person *no* noun • *ashita no gogo* (tomorrow afternoon) – use of the particle *wa* in negative answers or as a contrasting element – use of the particle *ga* to combine two sentences that express contrasting ideas [conjunction] – time expressions without the particle *ni*.	*Students are able to:* • recognize that, in many ways, the Japanese language reflects Japanese society • recognize that *kanji* represent units of meaning, not just particular sounds, as is the case with *hiragana* or *katakana*; the reading of the same *kanji* used in the writing of different words or parts of words could be completely different, but they usually share the same meaning • exhibit the following grammatical knowledge in their language use: – verb *masen deshita* – noun *janakatta desu/ja arimasen deshita* – TE form of verb + *imasu* [progressive actions] – person/animal *ga* quantity *imasu* – person/animal *wa* ~ *ga* ~ *desu* – ~ *ga daisuki desu* (I really like ~) – TA form of adjectives [past aspect] *katta* – the verb + *tai* form is not normally used to ask someone's desires, except with close friends or family members – ~ *kara* ~ *made* (from ~ to ~) – person *ni aimasu* [meet someone] – double particles: • *ni wa, e wa* [locations; topical] • *ni mo, e mo* [locations; inclusive] (continued)

	LEVEL 1 Self and Surroundings	LEVEL 2 Basic Needs 1: Food, Dwellings, Clothing
		(continued) • *o* [object marker] – locating objects: • *~ wa ~ ni arimasu* • *~ wa ~ desu* – adjective + *desu* – numerals: • *hitotsu, futatsu . . . too* • basic classifiers related to topics—counters/measure words.
• *Culture*	*Students are able to* identify the following cultural elements: • basic expressions in polite speech style used for greetings and addressing people • significance of interpersonal relationships; at this level the relationship between family group and outer groups; e.g., friends • some aspects of the Japanese school system; for example: – elementary school, junior high school, senior high school, university – school year level; e.g., first grade, first year of junior high school – timetable, what subjects are offered – what the Japanese classroom looks like – clubs and after-school activities that students participate in – holiday activities • some aspects of family life: – family bonds – role of family unit and individual members.	*Students are able to* identify the following cultural elements: • Japanese etiquette related to food and drink, table manners, visiting, leave-taking; i.e., how to bid farewell • traditional and modern Japanese food, such as fast food: – some examples of humorous loan words for food items: • *hotto sando, hambaagu suteeki, griin piisu* • the traditional Japanese meal, rice as a staple supplemented by a number of side dishes • daily eating patterns of the Japanese people and changing diet • traditional clothing: names of the parts of the *kimono*, different kinds of *kimono*; e.g., *yukata, furisode* • Japanese housing: – city dwelling and country living – houses and apartments: • *apaato* • *manshon* • *danchi* – names of rooms/sections in a house – where, how and when to take off shoes.

LEVEL 3 Basic Needs 2: Shopping and Transport	**LEVEL 4** Students' Interests	**LEVEL 5** My Japanese Counterpart: Hosting a Friend from Japan
		(continued) • read and write the following *kanji* characters and basic combinations. The characters can be introduced at any level of Stage 1. 一、二、三、四、五、六、七、八、九、十、百、千、万、円、日本、(日本) 語、上、下、中
Students are able to identify the following cultural elements: • Japanese currency and exchange rates • the words for Japanese shops and department stores and their functions in the Japanese consumer society • how Japanese people shop • transportation words • public transportation • differences in the cost of similar items between Japan and Canada.	*Students are able to* identify the following cultural elements: • youth culture in Japan; what young people of the same age group do in their spare time; e.g., popular music/groups, singers, TV programs, sports, computer games • lifestyles of young people in Japan • the names of Japanese traditional music, dancing and drama • popular sports in Japan and traditional sports • vacations.	*Students are able to* compare and contrast the following cultural aspects with Canadian ways: • Japanese education system; for example: – timetable/school subjects – *kurabu katsudoo*: after school extracurricular activities – school buildings – cleaning the classroom – school excursions – *juku* (cram school), after-school study program – *kyuushoku* and *obentoo* (fast food and lunches) • the family: – family ties – holiday activities – family occasions • standard of living: – how people spend their time – Japanese housing and household items – city life and country life – clothing • Japanese diet and dining etiquette • gift-giving customs and etiquette appropriate for particular occasions.

	LEVEL 1 Self and Surroundings	**LEVEL 2** Basic Needs 1: Food, Dwellings, Clothing
• *Concepts*	*Students are able to* appreciate and understand the following concepts: • the importance of manners, customs and body language • social frameworks—in-group versus out-group: – family members versus nonfamily members – school club members versus nonclub members • *meishi* (business card) • omission of first and second person pronouns, *watashi* and *anata* (I and you) **Note**: The pronoun *anata* (you) is not used when talking to one's seniors. • another form of writing, which is different from English; different from the Roman alphabet.	*Students are able to* appreciate and understand the following concepts: • personal hygiene is important; for example: – distinctive outdoor and indoor footwear: • corridor slippers • toilet slippers – use of *oshibori* (a wet towel) to wipe hands before the meal at a restaurant or at someone's home – bathing every night; some, mostly young, people have an *asa shan* (shower or wash hair) in the morning – hanging *futons* outside to be aired out • rice is important; for example: – using the same word for cooked rice and for meal – devoting *sake* wine, which is made from rice, to the gods on ceremonial occasions • dressing appropriately for particular occasions is important • generally, people are proud of uniforms, such as school uniforms, the symbol of a particular group • multipurpose use of rooms in a Japanese house to indicate that the family, as a whole, is considered more important than the individuals of whom it consists.

LEVEL 3 Basic Needs 2: Shopping and Transport	LEVEL 4 Students' Interests	LEVEL 5 My Japanese Counterpart: Hosting a Friend from Japan
Students are able to appreciate and understand the following concepts: • courtesy/quality of service; e.g., elevator/escalator hostess • shopping as a cultural experience, not merely a function; for example: – Japanese department stores organize cultural activities; people go to department stores not only to shop but also to participate in exhibitions, fashion shows and culture/art, or language classes – for many people, shopping, except for groceries, can be a leisure activity in Japan • manner of speech is important; saying "no" abruptly can hurt other people's feelings.	*Students are able to* appreciate and understand the following concepts: • value systems of the *shin jinrui* (new human species or younger generation); generation gap/ tension between traditional values and contemporary values • perceptions of tradition; for example: – traditional concepts of "groupism" versus Western-inspired individualism – popularity of traditional music, dance and drama.	*Students are able to* appreciate and understand the following concepts: • the Japanese language reflects the society in so many ways; for example: – The notion of "frame"— where everyone is and who they are with at that moment; such as with family or with a senior member of the same company in or outside of the office, influences the way in which people talk and behave • Western influence on the way of life: – family structure – dwellings – clothing – food – sports – music • practices in personal health and hygiene: – wearing a mask when one has a cold, or when children are serving hot lunch at school – bathing for relaxation, as well as for hygiene – Japanese-style toilet • frequent exchange of gifts to maintain social relationships.

STAGE 1: INTRODUCTION TO JAPAN (continued)

	LEVEL 1 Self and Surroundings	**LEVEL 2** Basic Needs 1: Food, Dwellings, Clothing
SKILLS • *Linguistic* – Functions	*Students are able to:* • greet each other appropriately as students within the same age group • greet their seniors appropriately • introduce themselves to others of the same age • introduce one's family, using in-group family terms, to others of the same age and also to seniors • exchange information: inquire about personal matters regarding name; group, such as school, class; age; where residing and family members; using out-group family terms, and responding to questions, using in-group family terms • introduce one's family to others, using in-group terms • introduce friends to family members, teachers and friends • understand and respond to basic classroom instructions • express likes and dislikes about school subjects in a simple form • express personal interests • give and respond to simple instructions, using the TE form casual request; *kiite*, *mite* • make simple requests in polite speech style, using the TE form of verb + *kudasai* • attract someone's attention • deny statements • ask someone to speak slowly; e.g., *yukkuri itte kudasai.*	*Students are able to:* • describe colours and sizes • use correct counters for some food and drink items and clothing • ask someone's personal preference regarding food and drink • offer food and drink to a visitor • make arrangements to visit someone, using where and what time they will meet • invite someone to one's home • use the telephone as a medium to convey simple messages • express choice • discuss likes and dislikes about food and clothing • specify the location of objects, in a particular place, on top of/under/in front of/behind something • tell the time by hours • inquire about topics of interest, and collect basic information • extract information, such as sale items and costs, from printed materials—magazines, books, advertisements • express apology to: – a teacher and an adult – friends and family members • respond to an apology • indicate lack of understanding of what is being said • ask for clarification: "What is ~ in English?": – *~ eigo de nan desu ka.* – *~ wa eigo de nan desu ka.*

LEVEL 3 Basic Needs 2: Shopping and Transport	**LEVEL 4** Students' Interests	**LEVEL 5** My Japanese Counterpart: Hosting a Friend from Japan
Students are able to: • make a plan to go shopping, discussing where to go, who is going and what kind of public transport to use • accept, decline and defer invitations • suggest an alternative place and time • obtain basic necessary information, such as price and size, in order to purchase something • describe measurement, shapes, colours and sizes • use correct counters for the nouns introduced so far and in this level • purchase goods • exchange information on familiar items that are produced in Japan or Canada • tell time in Japanese • discuss the difference in cost of similar items in Japan and in Canada • make inquiries • talk about past events: what students did, ate, drank, where they went yesterday, the day before yesterday, last weekend, etc. • express likes and dislikes, preferences in clothing, food, transportation, familiar objects • express interest and praise • ask for permission to go shopping • attract attention, politely, of the shop assistant, using preliminary expressions like: *"Anoo . . . sumimasen ga . . ."* (Ah, excuse me, but . . .) • seek confirmation.	*Students are able to:* • describe daily routine activities, joining two or three actions • tell what they do often, what they never do and what they do not do much • talk about their interests/what they do in their spare time • express likes and dislikes regarding activities • express desires/wants • tell the time by the minute, and use time as a reference • express personal preferences, using superlatives • express reasons in simple sentences • make arrangements for a leisure activity • give and react to compliments • ask for permission in polite speech • give encouragement • praise someone • express what one is good at • describe possession.	*Students are able to:* • introduce themselves, including information on family and pets • describe physical characteristics of people and pets • talk about things they do together with family and friends • express aches and pains; describe problems • inquire about how someone feels • talk about daily routine in detail, including specific times • make a schedule of activities or plan for a trip • ask for permission • express likes and dislikes • express desires/wants • inquire about other people's wishes/desires • find out what time things start and finish • inquire about the feelings and opinions of others, regarding a past experience • show someone how to perform a task • give information in written or spoken form • describe and explain the difference between Japanese and Canadian life at a survival level; e.g., immediate needs.

STAGE 1: INTRODUCTION TO JAPAN (continued)

	LEVEL 1 Self and Surroundings	**LEVEL 2** Basic Needs 1: Food, Dwellings, Clothing
• *Linguistic* – Skills	*Students are able to:* • pronounce *katakana* words, mainly names and some classroom objects • pronounce *hiragana* words with small *tsu*, double consonants, except double n's, and devoiced vowels • manage correct intonation for questions • write *hiragana* for frequently used words and some *kanji* characters: – by labelling: objects around classroom, terms for family members. Teachers may wish to write the names of family members in *katakana* – by making personal *meishi* cards in *katakana*.	*Students are able to:* • pronounce: – *katakana* words for food and clothing items • pronounce and discriminate: – words with two successive vowels – *n* before *na, ni, nu, ne, no* – *n* between vowels – *u* after *o, ko, so, to, no, ho, mo, yo, ro* with such exceptions as *too, honoo, koori* • write a simple passage on the topics assigned for this level, using visual aids • present a simple personal account in front of a group of people, using visual aids.
• *Sociocultural*	*Students are able to:* • bow appropriately in situations, such as when greeting a group of people of the same age; to family members; to seniors • use basic *aizuchi—aa, soo desu ka, soo, so* (Oh, is that so . . .).	*Students are able to:* • manage telephone etiquette: – know how to greet – ask for someone in particular – conclude a conversation • perform manners/etiquette associated with maintaining relationships; for example: – when visiting someone – when being offered food and drink – when eating – when leaving someone's home.

LEVEL 3 Basic Needs 2: Shopping and Transport	**LEVEL 4** Students' Interests	**LEVEL 5** My Japanese Counterpart: Hosting a Friend from Japan
Students are able to: • pronounce: – *katakana* words; e.g., clothing, sizes, colours, some transport words – *hiragana* words with double or triple vowels; e.g., *ei, ui, aoi* • write a simple passage in *hiragana* without hesitation • be involved in a short conversation, using visual or written aids.	*Students are able to:* • pronounce *hiragana* words, sentences and passages with relative accuracy • write two or three simple passages; e.g., letter to a pen pal describing personal interests.	*Students are able to* continue developing previously acquired skills: • write a letter of welcome to a Japanese student of a similar age • write a plan or school timetable or personal schedule • fill in a date book, a schedule in point form • initiate, maintain and conclude a short conversation related to topics introduced at this level • take a Japanese person around, explaining and using public transport • solicit agreement, using voice tone and the terminal discourse particle ~ne • present a short speech in front of a group of people, a self-introduction or welcome speech • interview—know the right manners to interview different people of various age groups.
Students are able to: • decline a request or invitation without being abrupt, using the expression "*~ wa chotto . . .*" or the tone of voice + ending "*~ desu ka . . .*" • know how to handle money—never throw notes and coins.	*Students are able to:* • express hesitation before giving a reply, using "*~ desu ka. Eeto . . .*" • respond to praise with a tone of hesitation; e.g., "*Iie, mada mada desu.*" (No, not yet . . .) • apologize by bowing.	*Students are able to:* • dress, sit and know how to bow appropriately in different situations • keep an appropriate distance (kinesthetics) • be aware of the different levels of speech according to the person being addressed • know how to receive gifts, and when and how to open them • know how to express gratitude—little or no hugging and kissing, or even hand shaking • know how to take turns in conversation, and understand how order of speaking is determined.

STAGE 1: INTRODUCTION TO JAPAN (continued)

	LEVEL 1 Self and Surroundings	**LEVEL 2** Basic Needs 1: Food, Dwellings, Clothing
• *Cognitive*	*Students are able to:* • observe and identify familiar objects • find and select certain information on topics assigned for this level • categorize information on family, friends and school.	*Students are able to:* • identify similarities and differences in *hiragana* symbols in terms of shape, which makes them easier to remember • identify word clues that recur in questions, such as question words and particles • place in order and categorize data • make decisions in consultation with others • solve problems • make simple plans.
ATTITUDES	*Students are able to* demonstrate interest in a new language and culture. They are aware of "respect" in social forms (heteronomy).	*Students are able to* appreciate the way in which Japanese people try to maintain their tradition while also adopting a modern style of living.

LEVEL 3 Basic Needs 2: Shopping and Transport	**LEVEL 4** Students' Interests	**LEVEL 5** My Japanese Counterpart: Hosting a Friend from Japan
Students are able to: • make plans • negotiate when obtaining goods or services • rank and priorize • compare and contrast • extract information from graphic formats • organize information, using such visuals as graphs and charts.	*Students are able to:* • make decisions • organize a plan • guess the meaning of loan words • predict what will be said • identify problems in communication, and apply strategies to solve them.	*Students are able to:* • process mistakes and learn from them • make a plan or schedule • be involved in situations where problem solving and decision making are necessary, and develop those skills • develop problem-solving skills by assisting their Japanese counterparts in various situations.
Students are able to appreciate Japanese politeness and high-quality customer services related to shopping.	*Students are able to* recognize that they share many similar interests with the young people of Japan. They appreciate the similarities and differences in lifestyles in this age group.	*Students are able to* demonstrate willingness to be involved in learning activities, and to take risks in using the language.

STAGE 2: JAPAN TODAY

	LEVEL 1 Land and People	LEVEL 2 Customs
KNOWLEDGE • *Language*	*Students are able to:* • recognize all phonetic symbols in the *katakana* table • exhibit the following grammatical knowledge in their language use: – negative forms of adjectives and adjectival nouns: • KU form of adjective + *nai* • adjectival noun + *ja nai* • KU form + *arimasen* – past progressive form of verb, TE form of verb + *imashita* – topic *wa*, subject *ga ~ desu* [minor and major sentence subject] – past form of adjectival nouns: adjectival noun + *deshita* – joining sentences, using *de:* • noun + *de* • adjectival noun + *de* • TE form of adjectives – conjunctions: *soshite, dakara* – probability: adjective + *deshoo* – *no* [a noun modifying another noun] – past negative form of adjectives and adjectival nouns: • KU form of adjective + *nakatta* • adjectival noun + *ja arimasen deshita/a nakatta desu.*	*Students are able to:* • recognize honorific and humble expressions used when giving and receiving, offering and eating food when visiting, and in other social situations; e.g., *tsumaranai mono desu ga/nani mo arimasen ga* • exhibit the following grammatical knowledge in language use: – stem form of verb + *ni ikimasu/kimasu* (go/come for the purpose of ~) – different functions of *ni* in giving and receiving *~ ni agemasu/kara (ni) moraimasu/~ ni kuremasu* – base form of adjective + *soo desu* (it looks ~) – stem form of verb + *tai* [desiderative].
• *Culture*	*Students are able to* identify the following cultural elements: • Japanese history overview; events and people in: – early period – age of feudalism – breakdown of feudalism – Second World War • Ainu people and their life (continued)	*Students are able to* identify the following cultural elements: • the two major religions in Japan; Shintoism and Buddhism • Shintoism, including: – *miyamairi*, the blessing of newborn babies – *shichi go san*, the celebration of children's ages (continued)

LEVEL 3 Arts and Literature	LEVEL 4 Work	LEVEL 5 Living in Japan— Going to Japan
Students are able to: • recognize how *hiragana*, *katakana* and *kanji* were developed • distinguish the difference between written and spoken forms • recognize some stylistic differences in written formats • identify male and female speech • recognize that the question form in casual speech has different endings; use *no* ending and uprising tone • exhibit the following grammatical knowledge in their language use: – dictionary form of verbs [nonpast aspect only] verb *ru/u*, noun + *da* – TE form of verb + *kuremasen ka*/TE form of verb + *kurenai* – TE form of verb + *miru* [do something and see what it's like or what will happen] – potential form of verb, past form, negative and negative past forms of the above; e.g., *iku* → *ikemasu/taberu* → *taberaremasu* – the difference between *mieru*, *kikoeru* versus *mirareru*, *kikeru* [visibility and audibility versus ability to see and hear] – use of *kan* for duration of time.	*Students are able to:* • recognize that language reflects the hierarchical structures of Japanese society; humble words are used to describe one's own group members; for example, *uchi no Suzuki*, no title, such as *san*, is used when speaking of a member, even seniors, of the same company to an outsider • exhibit the following grammatical knowledge in their language use: – ~ *ni naritai desu* (want to become ~) – dictionary form of adjective + *kara desu* (the reason is that it is ~) – noun/adjectival noun + *da kara desu* (the reason is that it is ~) – dictionary form of verb + *kara desu* (the reason is that ~) – dictionary form of verb + *tsumori desu* (It is my intention to ~) – the particle *de*: • instrument *de* (by means of) • language/script *de* (by means of) – dictionary form of verb + *ka doo ka wakarimasen* (I do not know whether ~) – dictionary form of adjective.	*Students are able to:* • develop further previously introduced knowledge of grammar, together with the following structures: – pre-*nai* form of verb + *nai* [plain negative form] – plain negative form of adjectives – OO form of verb [volitional] – dictionary form of verb + *n desu* – dictionary form of adjective + *n desu* – adjectival noun + *na n desu* – particle *ni* + verb *noru* – *moo, mada* (already, not yet) • master the following *kanji* characters for active use by the end of Stage 2. 大、小、東、西、南、北、 国、山、川、年、月、日、 名、前、木、金、土、行、 見、火、水、時、間、学、 校、生、京、先、車、父、 母、子、人、家、出、入、 口、男、女、食、買、何
Students are able to identify the following cultural elements of traditional art forms: • tea ceremony, flower arranging, painting, calligraphy and brush ink painting • the relationship of art with Zen Buddhism and nature (continued)	*Students are able to* identify the following cultural elements: • how the workplace gives many Japanese people, especially Japanese men, fulfillment and a way to define their identity • the seniority system (continued)	*Students are able to* develop further their knowledge of the following cultural elements: • everyday life of a Japanese family • the transportation system around big cities, such as Tokyo • the educational system; how the Japanese people value education (continued)

STAGE 2: JAPAN TODAY (continued)

	LEVEL 1 Land and People	LEVEL 2 Customs
	(continued) • Japanese geographic features: weather, seasons, topography, climate, natural disasters, cities, population, transport system • geographical relationships with other countries of the world • historical relationships with and influences of other countries of the world • importance of living in harmony with nature, which is evident in many aspects of Japanese daily life.	(continued) – praying for success in school entrance examinations – marriage • Buddhism, including: – funerals – honouring of ancestors • Confucianism • differences in how people perceive religions/god(s) in Japan and in Canada • festivals and annual events in Japan • special food prepared for festivals • how festivals are closely related to seasons • the custom of reciprocal gift giving • proper manners and etiquette when: – eating – visiting someone's home – visiting someone in hospital – attending social functions, such as weddings – giving gifts.

LEVEL 3 Arts and Literature	LEVEL 4 Work	LEVEL 5 Living in Japan— Going to Japan
(continued) • literary forms: stories, diaries, *tanka* and *haiku* poems, folk tales • some historically important literary works; e.g., *The Tale of Genji* • how nature is always an important theme in Japanese classical literature; the varied climate of Japan has fostered among the people a keen awareness of nature • traditional theatre: *Bunraku, Kabuki, Noh* • Japanese musical instruments and the Japanese musical scale(s).	(continued) • the employment examinations that many companies give • the training sessions for new employees that *ichiryuu gaisha* (first-class companies) provide to: – instill in the minds of the young men and women, who until recently were students, the fact that they are now full members of *shakaijin* (society—literally "society people") – discipline them into being "good company members" by teaching a manner of speaking, posture, how to wear clothes, how to bow, how to hand over a business card, how to answer the telephone and how to receive visitors; e.g., ushering guests into a room, making sure that the guests sit in the right place • regular company social events, such as athletic competitions, trips and farewell and welcome parties, year-end and New Year's parties; all of which strengthen interpersonal relations and improve an organization's morale • the dissatisfaction of some employees about their positions being locked in and about being only a very small part of the company • how women think about their work and position in society • how people manage the household budget and how people spend their leisure time.	(continued) • etiquette and manners when visiting a senior, such as a father's business counterpart or a friend of the host family • about travelling in Japan: transportation, accommodation, activities, historical places of interest and costs • emergency telephone numbers; for example: – police (110/*hyaku too ban*) – fire and ambulance (119/*hyaku juukyuu ban*) – hospital • aspects of Japanese culture that are made up of many layers—old and new, foreign and native.

STAGE 2: JAPAN TODAY (continued)

	LEVEL 1 Land and People	**LEVEL 2** Customs
• *Concepts*	*Students are able to* appreciate and understand the following concepts: • historical concepts: cause and effect • ideas of selflessness and harmony with one's surroundings.	*Students are able to* appreciate and understand the following concepts: • reciprocity: Shinto beliefs make Japanese people conscious of a two-way relationship between the environment and their lives • the way the Japanese people feel about religion • the significance of special food items for particular occasions • how the frequent exchange of gifts shows the continuing importance of relations of obligation/gratitude • how, although a calendar year starts in January, school starts a new academic year in April, and new employees of a company start working in April, as spring is the beginning of new life.

LEVEL 3 Arts and Literature	LEVEL 4 Work	LEVEL 5 Living in Japan— Going to Japan
Students are able to appreciate and understand the following concepts: • "Way"—a process rather than a goal • how the tea ceremony, flower arranging, garden landscaping and many other arts exemplify the Japanese view of nature • the Japanese concept of nature • how the Japanese tend to avoid argument.	*Students are able to* appreciate and understand the following concepts: • work ethic—how Japanese people, especially men, feel about their work and about being a salary man • group identification • vertical relationships/seniority rule • *shakaijin* (persons of society).	*Students are able to* appreciate and understand the following concepts: • how the everyday life of a Japanese is governed by traditions and rules of society.

STAGE 2: JAPAN TODAY (continued)

	LEVEL 1 Land and People	**LEVEL 2** Customs
SKILLS • *Linguistic* – Functions	*Students are able to:* • name countries and cities of the world • talk about the size and population of countries or cities, using numerals and correct counters for height and size • name the oceans surrounding Japan • identify nationalities and languages • describe the geographic characteristics of Japan: volcanic actions, mountain ranges, major rivers, big cities, location, population, size • use the 24-hour clock and talk about time differences between countries • describe the characteristics of the four seasons of Japan • discuss weather, using weather terms and temperatures • make comparisons between geographic features in Japan and Canada, in terms of size, population and climate • name the eras in Japanese history • describe past events in history, and name some people involved in historical events • express a "guess" or prediction.	*Students are able to:* • identify dates of the month • express emotions; for example: I am happy, pleased, having fun, afraid, disgusted, sad, bored, lonely • ask permission to go out, giving detailed information, such as the type of activity, where they are going, time of return, who is involved • withhold and grant permission • express "go and do something" • express "something, someone, somewhere, nothing, no one, no where" • express giving and receiving, identifying: "who" gives/receives "what" to/from "whom" • express how something looks.
– Skills	*Students are able to:* • write simple reports on assigned topics • label maps, charts and diagrams, using *hiragana*, *katakana* and *kanji*.	*Students are able to:* • extract information on assigned topics from published materials, such as magazines, brochures and books • create and present short oral summaries • write a description or narrative in simple sentences or a short paragraph, using present and/or past aspect.

LEVEL 3 Arts and Literature	LEVEL 4 Work	LEVEL 5 Living in Japan— Going to Japan
Students are able to: • name traditional arts, including performing arts • name the main literary forms • name some Japanese musical instruments • make arrangements to do something with friends; finalize, confirm arrangements • formulate questions to get such information on art forms and literature as dates, rules involved, etc. • request a favour from friends, family members and others • respond to a request • suggest alternative arrangements regarding time, place, etc. • express duration of time • express "try doing/do ~ and see" • ask for personal reflections about stories, music and artifacts • express abilities and inabilities.	*Students are able to:* • discuss what occupation they are interested in as a future career • give reasons for the above in simple sentences • express intentions for the future • express the use of writing implements and the use of scripts • express uncertainty about the future.	*Students are able to:* • narrate past events, using the *da* style in: – written form; diary, short stories – casual speech • invite Japanese friends to do something in plain form, casual speech, using the *nai* form of verb or the OO form of verb • understand instructions, and ask questions regarding mailing letters, cards and parcels • ask for directions to find such things as a telephone box, a restaurant • ask opinions about something • seek information regarding travel • express concern regarding lost property: – seek assistance at a lost and found desk – explain where something was lost, using "I guess ~ " – describe the shape, size and colour of a lost object • explain personal health problems • persuade someone to do something • talk about anxiety • ask for instructions about how to use something (*dooyatte/tsukai kata)* • follow instructions on how to operate something • attract someone's attention when asking for directions.
Students are able to: • use a dictionary • participate spontaneously in a short conversation or discussion • make a list of events in a folktale • write a short, imaginative story • create *haiku* poems, using familiar words.	*Students are able to:* • fill in a job application form or a questionnaire, using coherent sentences • interact with an interviewer and answer questions.	*Students are able to:* • write short stories, letters to a senior, and short reports • write diaries, short skits, personal letters and notes in casual, plain style.

	LEVEL 1 Land and People	LEVEL 2 Customs
• *Sociocultural*	*Students are able to:* • start a conversation by referring to the weather or climate, a common way of starting a conversation in Japan, and end it in an appropriate way.	*Students are able to* exhibit appropriate behaviour when visiting someone: • take off shoes at the entrance and not step on the floor with bare feet • take off coats at an appropriate time • choose what to take/give, especially if visiting a sick person • present and open a gift • behave appropriately, and use proper manners, when eating and drinking • deal with leave-taking—*odaijini* only to a sick person (take care of yourself) • refer to the latest visit, and say "thank you" to the host or hostess a few days after the visit.
• *Cognitive*	*Students are able to:* • search for specific information from various sources • interpret data • make a comparison • make an objective judgement • classify information • predict • put historical events in sequence.	*Students are able to:* • identify information from written and visual materials • interpret symbolism and religious ceremonies • deduce how religion and beliefs influence ways of life.
ATTITUDES	*Students are able to* appreciate fundamental similarities between how the countries of the world have participated in historical events and how individual human beings behave.	*Students are able to* appreciate the religious beliefs and social rules of Japanese people.

LEVEL 3 Arts and Literature	LEVEL 4 Work	LEVEL 5 Living in Japan— Going to Japan
Students are able to: • express disagreement politely, using *aizuchi* first, *soo desu ne*, then using the word *demo* • start a conversation about a request by indicating hesitation, saying: – *anoo ~* – *anoo, onegai ga aru n desu kedo*. (Ah, I have a favour to ask, but . . .)	*Students are able to* exhibit appropriate behaviour in a formal job interview situation, knowing: • how to dress • how to enter the room • how to bow • when and how to sit • how to answer questions, using normal form, polite speech (*desu/masu* form) • how to leave with an appropriate bow and a set phrase, such as *shitsurei shimasu*.	*Students are able to:* • react to a greeting from a person who has not been seen for a long time, using set expressions appropriate for the situation • ask about a person who has not been seen for a period of time • express surprise, understanding or concern, using the appropriate tone • react to praise, using humble expressions • deal with a problem when telephoning; e.g., wrong number • ask for rephrasing when having trouble understanding: – "Excuse me, I don't understand." – "Excuse me, you spoke too fast." – "Excuse me, some words were too difficult." – "Excuse me, I couldn't catch what you said." (on the telephone) • use basic set phrases to write a letter to a senior person.
Students are able to: • evaluate stories and give personal opinions • classify information • put information in sequence.	*Students are able to:* • inquire about how interpersonal relationships are conducted in Japan • gather, select and organize data appropriate to a purpose • analyze and evaluate data • synthesize.	*Students are able to:* • select and develop ideas for evaluative and informative writing • organize data • process information • make a judgement.
Students are able to show their appreciation for Japanese art and literature, and appreciate the aesthetic features of the language.	*Students are able to* respect people's different perspectives about how best to conduct one's life.	*Students are able to* understand and accept different ways of thinking. They demonstrate a high level of interest in learning about any aspect of life and culture in Japan.

STAGE 3: JAPAN AND THE WORLD

	LEVEL 1 National Treasures	**LEVEL 2** Economics and Politics
KNOWLEDGE • *Language*	*Students are able to:* • recognize that English has borrowed some Japanese words • exhibit the following grammatical knowledge in their language use: – ability ~ *ga dekiru (dekimasu)* [potential] – dictionary form of verb + *koto ga dekiru/koto ga dekinai (dekimasen)* [potential] – the particle *de* • material *de dekiteiru* (is made of ~) – dictionary form of adjective + *to omou (omoimasu)* (I think it is ~) – noun/adjectival noun + *da to omou* (I think it is ~) – dictionary form of verb + *to omou* (I think ~) – TA form of verb [plain past] – TE form of verb + *kara* (after/since ~).	*Students are able to:* • recognize that language use changes according to the context; in slogans and advertisements some *hiragana* words are transcribed in *katakana* or an English phrase is transcribed in *hiragana* to have impact or create a certain nuance • exhibit the following grammatical knowledge in their language use: – verb forms: plain, negative, past – presumptive expressions: dictionary form of verb + *daroo/ka mo shirenai* – changing adjectives into adverbs: • KU form of adjective • adjectival noun + *ni*.

LEVEL 3 Science and Technology	**LEVEL 4** Global Relationships	**LEVEL 5** Values
Students are able to: • recognize that sound symbols, *giseigo* and *gitaigo*, are abundant in Japanese • exhibit the following grammatical knowledge in their language use: – pre-*nai* form of verb + *naide kudasai* (please do not ~) – pre-*nai* form of verb + *nakereba naranai* (must ~) – pre-*nai* form of verb + *nakutemo ii* (do not have to ~) – TA form of verb + *hoo ga ii* (had better ~) – pre-*nai* form of verb + *hoo ga ii* (had better not ~).	*Students are able to:* • recognize that the Japanese have many expressions for showing respect, and that such expressions deal with being polite: – to a person – toward a person's belongings – toward a person's condition – toward a person's actions • use some of the expressions for being polite • exhibit the following grammatical knowledge in their language use: – *~ to ~ to dotchi ga* (which) – *~ to ~ to ~ to (dewa) dore ga ichiban* (which) – *~ no hoo ga ~ to omou* (I think ~ is ~) – *~ hoo ga ichiban ~* (the best ~) – *~ to chigau* (different from ~) – *~ to onaji* (the same as ~).	*Students are able to:* • recognize and use some of the humble expressions for referring to oneself, persons or things associated with oneself, one's condition, and one's actions when speaking politely • develop and improve previously acquired knowledge of grammar and learn the following structures: – dictionary form of verb + *toki*; dictionary form of adjective + *toki;* noun + *no toki* (when/at the time of ~) – relative clauses and the particle *ga* – TARI form of verb + TARI form of verb + *suru* – dictionary form of verb + *tame ni* (for the purpose of ~) – *motte iku/kuru, tsurete iku/kuru* – noun *to iu* noun • use the following *kanji* characters competently in their writing by the end of Stage 3. 右、左、外、町、店、雨、雪、電、手、足、目、耳、今、去、来、毎、聞、話、読、会、社、高、安、長、新、海、住、所、分、半、午、後、書、休、天、気、白、友、曜、々

STAGE 3: JAPAN AND THE WORLD (continued)

	LEVEL 1 National Treasures	**LEVEL 2** Economics and Politics
• *Culture*	*Students are able to*, as a result of their general studies of Japanese architecture, fine arts and literature, identify such cultural elements as: • miniaturization/attention to detail, which has been transferred to modern technology • international appreciation/interest in Japanese painting, especially wood block prints of the Edo period, *ukiyoe* and *origami* • the popularity of artistic Japanese items in North American daily life; for example, *bonsai, futons, kimonos* • integration of Japanese words, ideas, concepts in North American everyday life; for example, *hibachi, futon, sushi, kimono, netsuke, ninja, bushido, samurai, shogun, seppuku, bonsai, honne and tatemae, judo, karate, karaoke* • the influence of Japanese film production; e.g., director Kurosawa's internationally acclaimed films.	*Students are able to*, as a result of their general studies of economics and politics, identify such cultural elements as: • the Japanese economy: – historical perspectives – recovery and rapid growth of the postwar economy – Japanese economic structure • advantages and disadvantages of continued Japanese economic growth • the economic lifestyle of the Japanese: – a very narrow gap between rich and poor • the Japanese industrial structure, and changes in that structure • the Japanese constitution's three principles: – popular sovereignty/politics by the people – pacifism/renunciation of war – human rights • the political system and the *Diet* (Japanese parliament) • political parties.

LEVEL 3 Science and Technology	**LEVEL 4** Global Relationships	**LEVEL 5** Values
Students are able to, as a result of their general studies of science and technology, identify such cultural elements as: • some aspects of the recent rapid developments in Japan's high technology; for example, such machinery as industrial robots, computer science, telecommunications, biotechnology, medical engineering, pharmaceutical technology • interaction between Japan and countries of the world in the field of science and technology; for example, joint projects in space and medical technology • Japan's energy consumption and energy base, and alternatives • some aspects of Japan as an information society: – 24-hour direct satellite broadcasting – Information Network System(s) – Local Area Networks • the "land of newspapers" • pollution problems, and how the Japanese deal with them • environmental movements: – recycling movement – Greenpeace Japan – use of solar energy – restrictions on energy consumption • Japan's role in the logging industry, and its tendency toward excess; the pulp and paper industry in Alberta—pros and cons.	*Students are able to*, as a result of their general studies of the relationships between Japan and the nations of the world, identify such cultural elements as: • Japan's economy and trade relationships, for example: – trade dependency of major nations – import dependency for major commodities – import and export structures for commodities – import and export trade by nation and value • trade friction: – reasons why serious trade friction has arisen, for example GATT – strategies and policy changes to dispel trade friction • economic cooperation and Official Development Assistance • cultural exchange/twinning • joint projects • Japan's contributions to the world: – United Nations – World Health Organization • multinational companies—Japanese companies establishing businesses outside Japan: – problems that employees and their families face overseas; e.g., children's education.	*Students are able to* recall their previous knowledge and gain deeper understanding of the following topics: • strong belief in good education; for example: – acceptance by a good university eases the way to employment with a prestigious company, which is the ultimate goal – drop-outs and bullying – suicide/individual and group • tradition and change as it relates to: – family structures – changes in family relationships – marriage and divorce • the reality behind perceived affluence; for example: – middle class standards – waning of ethical judgement – age of abundance and nonjudicial use of resources • social roles, such as: – economic growth and changes in the makeup of industry have increased the number of women working outside the traditional workplaces of home and field.

	LEVEL 1 National Treasures	LEVEL 2 Economics and Politics
• *Concepts*	*Students are able to* appreciate and understand the following concepts: • symbolism: – birds, plants and aspects of nature used to design a family crest – a kind of universe in miniature created in gardens and *bonsai* • craftsmanship, as the creative force in the production of traditional fine Japanese artifacts and as found in modern technological innovations.	*Students are able to* appreciate and understand the following concepts: • the structure and functions of Japanese government, and the participation of its citizens • Japan's economic system.
SKILLS • *Linguistic* – Functions	*Students are able to:* • express ability and inability • describe the temporal sequence between two events, using the TE form of verb + *kara* • describe some characteristics of Japanese architecture in simple terms • express opinions, using relatively complex structures • express preference, giving reasons • describe some characteristics of *ukiyoe*, using basic vocabulary • follow instructions on how to make something in *origami* art.	*Students are able to:* • describe the government structures of Japan and Canada in simple sentences • express prediction, using the dictionary form of verb + *ka mo shirenai* • express sympathy, regret and concerns about friends and family, rephrase/confirm when guessing the meaning of a word; e.g., ~ *tte* ~ *no koto desu ka.*
– Skills	*Students are able to:* • express ideas, opinions and emotions, with some assistance, clearly and coherently in an article • present a report in class about some aspects of Japanese arts • participate in a conversation and discuss personal experiences, using prepared notes.	*Students are able to:* • write a slogan for an election poster or an advertisement • participate in a short discussion, using prepared notes • write an essay, a message or a narrative of four or five connected paragraphs.
• *Sociocultural*		

LEVEL 3 Science and Technology	**LEVEL 4** Global Relationships	**LEVEL 5** Values
Students are able to appreciate and understand the following concepts: • environmentalism • how technological development influences lifestyle and values.	*Students are able to* appreciate and understand the following concepts: • disparity and diversity in levels of economic development between Japan and other nations • interdependence among nations: economy, trade, technology, communication • globalization.	*Students are able to* appreciate and understand the following concepts: • changes in value systems • quality of life • moral systems.
Students are able to: • express warning and mild prohibition, using the pre-*nai* form of verb + *naide kudasai* • express stronger prohibition, using the TE form of verb + *wa ikemasen* • describe rules • express obligation • express intentions for the near future • make suggestions/give advice.	*Students are able to:* • make comparisons between two things • make comparisons among more than two things • express opinions indicating preference or judgement • tell how A is different from B • tell how A is the same as B • use some expressions of respect, according to their relationship with another speaker.	*Students are able to:* • describe the benefit or purpose of something (in order to, for the sake of) • make a list of actions and states, using the ~ TARI ~ TARI form • describe something or someone in detail, using relative clauses • clarify information about an object, person and place, which is called X • use some humble expressions.
Students are able to: • link phrases and sentences together • write a description of facts or phenomena, using a range of language structures, approximately one and one half to two *genkooyooshi* sheets (Japanese manuscript paper); i.e., 600 to 800 characters.	*Students are able to:* • express ideas and opinions, and provide supporting information in a summary or essay—one and one half to two *genkooyooshi*.	*Students are able to:* • make an appointment for an interview, using the telephone • interview a native Japanese speaker, using a tape recorder, to seek opinions on topics of interest • transcribe the recorded information • write articles to create a class newsletter or newspaper.
		Students are able to reflect in their behaviour the various forms of respect that enables successful interaction with native Japanese speakers.

STAGE 3: JAPAN AND THE WORLD (continued)

	LEVEL 1 National Treasures	**LEVEL 2** Economics and Politics
• *Cognitive*	*Students are able to:* • make a research plan • identify information • classify information • contrast and compare • analyze data • put events in sequence.	*Students are able to:* • make a research plan • identify and use relevant information from various sources • put information in sequence • compare and contrast.
ATTITUDES	*Students are able to* recognize that human nature is basically the same, and beauty and artistic work can be understood despite language barriers.	*Students are able to* appreciate the strengths and weaknesses of different economic and political systems.

LEVEL 3 Science and Technology	**LEVEL 4** Global Relationships	**LEVEL 5** Values
Students are able to: • identify pros and cons of certain issues • examine issues critically from different perspectives • interpret and use information from graphs, charts and tables.	*Students are able to:* • observe and summarize materials • interpret and use information from maps and graphs • identify appropriate information • evaluate issues and situations • see the situation from micro and macro points of view.	*Students are able to:* • compare and contrast the value systems of Japan and Canada • select relevant information.
Students are able to develop: • intellectual curiosity and interest in current issues • open-mindedness and respect for the points of view of others.	*Students are able to* appreciate the interdependent nature of the world. They are willing to ponder a variety of perspectives on global relationships.	*Students are able to* gain a certain level of bicultural competence by working out different ways of perceiving cultural experiences and integrating some Japanese values into their own value system.

STAGE 4: JAPAN TOMORROW

	LEVEL 1 Social Issues	**LEVEL 2** Social Change
KNOWLEDGE • *Language*	*Students are able to*: • identify some discourse forms in Japanese that are shaped by specific values and beliefs • exhibit the following grammatical knowledge in their language use: – TE form of verb + *ageru/ sashiageru* [giving to others] – TE form of verb + *morau/itadaku* [receiving] – TE form of verb + *kureru/kudasaru* [others give to oneself] – ~ *node* ~ [reason] – ~ *kara* ~ [reason] – dictionary form of verb + *nagara* (while ~) – *dake*, *shika/dake shika* [exclusives] – dictionary form of verb + *mae ni* (before ~) – TA form of verb + *ato de* (after ~).	*Students are able to:* • recognize how different forms of the Japanese language serve different purposes • exhibit the following grammatical knowledge in language use: – dictionary form of verb + *noni* (even though ~) – dictionary form of adjective + *noni* (even though ~) – adjectival noun + *na noni* (even though ~) – TE form of verb + *mo* (even if ~) – adjectival noun/noun + *demo* (even if it is ~) – TE form of adjective + *mo* (even if it is ~) – TA form of verb + *koto ga aru* [experience] – TARA and BA forms of verbs/dictionary form of verb + *to* [conditionals] – noun + *nara* [conditional copula] – BA form of adjective [conditional] – adjectival noun + *nara* [conditional].
• *Culture*	*Students are able to*, in a discussion/research project, describe one or two of the following cultural/social aspects: • aging/population change • welfare of socially disadvantaged people • health care system, and abuse of the system • cultural diversity in Japan and in Canada, and immigration and immigration policies • racism • equality of, or discrimination against, some socially disadvantaged groups of people.	*Students are able to*, in a discussion/research project, describe, in depth, one or two of the following cultural/social aspects: • changing values: – materialism and how people feel about it • changing traditions • changing lifestyles • changing roles: – women's and men's roles – the range of social roles and power relationships in different groups; e.g., family and the working world.

LEVEL 3 Global Relationships	**LEVEL 4** Science/Technology	**LEVEL 5** The Working World
Students are able to: • exhibit the following grammatical knowledge in language use: – ~ *hodo* + negative ending (not as ~ as ~) – dictionary form of verb + *tokoro* – TA form of verb + *tokoro* – dictionary form of verb + *koto ni suru* (decide to ~) – noun + *ni suru* (decide upon ~) – dictionary form of verb or TA form of verb + *soo da* (I understand that ~. I hear that ~) – dictionary form of verb + *rashii* (I believe that ~) – dictionary form of verb + *yoo da* (It appears that ~).	*Students are able to:* • exhibit the following grammatical knowledge in language use: – TE form of verb + *hoshii* (want someone to ~) – dictionary form of verb + *yoo ni* (in order that ~) – TE form of verb + *oku* (~ for future purposes) – TE form of verb + *aru* (it is in a state of ~) – TE form of verb + *shimau* (~ regrettably/completely ~) – base form of adjective + *garu* – stem form of verb + *tagaru*. [third person desiderative].	*Students are able to:* • exhibit the following grammatical knowledge in language use: – stem form of verb + *ni naru* [honorific] – stem form of verb + *suru* [humble] – stem form of verb + *yasui/nikui* (easy to ~/ hard to ~) – stem form of verb + *sugiru* (excessively ~) – base form of adjective + *sugiru* (too ~) – dictionary form of verb + *koto ni naru* (it is decided that ~) – dictionary form of verb + *yoo ni naru* (it becomes such that ~) – TE form of verb [to express reason] • use an additional, specified, 150 *kanji* characters.
Students are able to, in a discussion/research project, identify, in depth, one or two of the following cultural/social aspects: • exchanges of personnel and new technology • political interaction: – financial assistance to needy nations – Japan's contribution to peacekeeping organizations • how interactions among nations involve a wide range of motives, methods and consequences: – World War II and its consequences – unstable relationships between Japan and some Asian nations • the increasing interdependence among nations.	*Students are able to,* in a discussion/research project, identify, in depth, one of the following cultural/social aspects: • medical questions: – euthanasia – biogenetics – animal testing • energy conservation • use of nuclear energy • ecology • new technologies.	*Students are able to:* • identify possible future careers, and the knowledge, skills and attitudes necessary for a particular career/job.

	LEVEL 1 Social Issues	LEVEL 2 Social Change
• *Concepts*	*Students are able to* develop at least one of the following concepts: • social values and their role in society • how Japanese and Canadian societies are influenced by changing political, economic and historical spheres • the cultural diversity of society in Japan and in Canada • stereotypes that individuals and the media tend to use • the dilemma of migrants: – retaining cultural conventions and values – adapting to a new environment • urbanization.	*Students are able to* develop at least one of the following concepts: • the process of social change and its influences on people and society • power relationships.
SKILLS • *Linguistic* – Functions	*Students are able to* perform the following functions fluently, using simple and complex expressions with infrequent hesitations and few errors: • ask someone to do something, using respectful expressions • describe an action that occurs simultaneously with another action • speak about doing a favour for someone • state that someone else is doing a favour • speak about receiving a favour.	*Students are able to* perform the following functions fluently, with infrequent hesitations and few errors: • express surprise/ disappointment/complaints • describe past experiences • seek assistance, and respond to the advice and suggestions appropriately • express agreement, by adding comments • hypothesize, by using a conditional clause.

LEVEL 3 Global Relationships	**LEVEL 4** Science/Technology	**LEVEL 5** The Working World
Students are able to develop at least one of the following concepts: • internationalism • conflict • interdependence • globalization.	*Students are able to* develop at least one of the following concepts: • the role/impact of individuals, or a particular group, in developing technology in science • technological developments and their social consequences • environmentalism • humanitarianism.	*Students are able to* develop the following concepts: • work and self • work relations • the work ethic.
Students are able to: • express comparison, using a grammatical indication of degree: A is not so ~ as B • describe a temporal state where a person: – has just done something – is about to do something • express a decision on future actions • make certain inferences on the basis of direct observation • describe an impression upon seeing something • make conjectures, based on direct observation/what was heard.	*Students are able to:* • ask a favour and respond to it • express a desire/wish of a third person • state a purpose • state what they plan to do • state that something is being done for future convenience • express regret/disappointment/ completion of action.	*Students are able to* develop further their fluency in performing the following functions: • use honorific, respectful, expressions when talking about/to seniors • use humble expressions when talking about oneself to seniors • give reasons in complex sentences • describe degree of difficulty • express complaint/dissatisfaction • state that a certain decision is made • describe a gradual change.

STAGE 4: JAPAN TOMORROW (continued)

	LEVEL 1 Social Issues	**LEVEL 2** Social Change
– Skills	*Students are able to*, with increased vocabulary and more complex structures: • identify ideas, opinions and feelings related to social issues appearing in simpler newspaper articles, adapted magazine articles, and recorded debates and interviews • write a short report or essay after collecting information from a range of sources, such as statistical documents, films and adapted written articles • present and respond to opinions in a discussion, providing supporting detail • maintain a file of data on current events.	*Students are able to:* • identify subtle/obvious persuasive tones in the language • present information in front of a group of people for 10 to 15 minutes, using audiovisuals and prepared notes • respond to questions and comments relating to the presentation • expand strategies for dealing with unfamiliar vocabulary and expressions.
• *Sociocultural*	*Students are able to* behave appropriately in various situations by applying previously acquired sociocultural knowledge spontaneously and successfully.	
• *Cognitive*	*Students are able to:* • record information in a variety of ways • identify different perspectives on a particular issue • organize data.	*Students are able to:* • analyze information • evaluate information • draw conclusions.
ATTITUDES	*Students are able to* attempt using Japanese extensively in interactive situations where native Japanese speakers are present.	*Students are able to* try expressing opinions on the basis of evidence; constructively examine the attitudes and values of others; and evaluate issues by considering a variety of points of view.

LEVEL 3 Global Relationships	**LEVEL 4** Science/Technology	**LEVEL 5** The Working World
Students are able to: • research and present information through a range of media, such as tapes, slides, photographs with captions, graphs and diagrams • report information effectively, without obvious memorization • capture the flavour of the language by paying attention to pronunciation and intonation • participate in a debate, with prepared notes.	*Students are able to:* • produce informative and/or evaluative writing that contains appropriate discourse and linguistic forms and correct expressions, and conveys the meaning clearly • formulate thoughts in a variety of discourse forms • monitor the correctness of their productions, written and oral, and ensure that messages are precise.	*Students are able to:* • find information, and organize it in graphic representations • write informative paragraphs to accompany the graphic representations.
Students are able to: • select relevant data • re-arrange data • categorize data • devise a plan for presenting data • compile and present data effectively.	*Students are able to:* • classify information • re-arrange information • show relationships between and among categorized items • justify personal opinions.	*Students are able to:* • summarize information • paraphrase • explain • design an effective method for communicating with a particular audience.
Students are able to clarify their personal values and beliefs by contrasting them with those of others. They are able to accept others' values and beliefs as they are, and to perceive experiences within the spheres of other value systems.	*Students are able to* appreciate the fact that they can use different writing styles for different purposes, and develop confidence in their skills.	*Students are able to* undertake further studies in Japanese in order to prepare for career opportunities.

STAGE 5: SPECIALIZED AREAS OF STUDY: CAREER-ORIENTED STREAMS/ HUMANITY STUDIES

	LEVEL 1 and LEVEL 2 Analytical Studies
KNOWLEDGE • *Language*	*Students are able to* engage in a variety of activities in a chosen field of specialization to enhance understanding of how language is used for specific purposes. They are able to use a variety of sentence patterns and stylistic devices to achieve their communicative intents effectively. *Students are able to* learn additional linguistic elements and an additional, selected, 250 *kanji* characters. Selections to be made in accordance with the needs of the specialized areas chosen.
• *Specialized Areas*	*Students are able to* acquire specialized knowledge as it relates to topics of choice; for example: • business correspondence (career-oriented studies) • policies for promoting tourism (tourism studies) • the economic, cultural and environmental impact of tourism (tourism studies) • the role/influence of media (mass media studies) • plot creation/social settings of stories (drama studies) • genres of literature and literary movements (literature studies).
• *Concepts*	*Students are able to* develop concepts related to the specialized fields of choice. Some suggested concepts include: • ethics in personal and business financial management (financial management studies) • structure of the industry (career-oriented studies) • markets (enterprise and innovation studies) • human relationships (literature/drama studies) • multiculturalism (literature/drama studies) • cultural/social stereotypes (mass media studies).

LEVEL 3, LEVEL 4 and LEVEL 5

Work Experience/Research Project/Production

Students are able to demonstrate competence in applying previously acquired linguistic knowledge and discourse strategies by conveying exact meanings in natural, interactive situations. They consciously select and use grammatical rules, vocabulary, expressions, intonations and pronunciation appropriate to the message/meaning to be communicated. They are able to make use of strategies to cope with unfamiliar texts. Students are able to identify linguistic elements that will enrich their language capacity, and they can verify the accuracy of these new elements.

Students are able to learn additional linguistic elements and an additional, selected, 250 *kanji* characters. Selections to be made in accordance with the needs of the specialized areas chosen.

Students are able to exhibit deeper understanding of the various conventions of a specialized area.

Students are able to identify an appropriate role for themselves and contribute to:

- successful completion of a final project (humanity studies)
- successful completion of a work experience session (work experience).

STAGE 5: SPECIALIZED AREAS OF STUDY: CAREER-ORIENTED STREAMS/ HUMANITY STUDIES (continued)

	LEVEL 1 and LEVEL 2 Analytical Studies
SKILLS • *Linguistic*	*Students are able to* extend and refine their knowledge of the language and their skills in a wide range of contexts for an increasing number of purposes, such as: • advertising • analyzing • arguing • asserting • comparing • debating • discussing • dramatizing • entertaining • generalizing • hypothesizing • influencing others • instructing • interpreting • justifying • negotiating • note-taking • recounting • reporting • retelling • reviewing • summarizing • synthesizing • translating *Students are able to:* • identify the main theme/topic/idea of oral and written texts • appreciate literary expressions/subtle nuances • converse with native Japanese speakers, making only a few errors in pronunciation, vocabulary or structure.
• *Sociocultural*	*Students are able*, in complex situations, to apply, spontaneously, different combinations of communication rules particular to Japanese social circumstances; for example: • switch-on rules—under what conditions? • variety rules—in what "language"? • setting rules—when and where? • participant rules—who? • content rules—what? • message rules—in what form? • channel rules—through what medium? • management rules.
• *Cognitive*	*Students are able to* organize their thoughts in a purposeful and extended manner whereby they can: • identify the task/problem • define and clarify major components • judge and relate relevant information • evaluate the procedures for drawing conclusions/solving problems. In addition, students become conscious of their thinking and develop self-monitoring for solving problems.

LEVEL 3, LEVEL 4 and LEVEL 5

Work Experience/Research Project/Production

Students are able to demonstrate a high level of competence in applying their previously acquired linguistic skills. They also demonstrate advanced proficiency in performing language functions in work situations where native Japanese speakers are involved, including Japanese speakers whom they do not know.

Students are able to handle communication problems by applying acquired knowledge and skills in a Japanese sociocultural setting.

Students are able to develop expertise in using creative thinking and innovative strategies to:

- set goals
- plan/generate ideas and alternative strategies
- solve problems
- make decisions
- negotiate.

STAGE 5: SPECIALIZED AREAS OF STUDY: CAREER-ORIENTED STREAMS/ HUMANITY STUDIES (continued)

	LEVEL 1 and LEVEL 2 Analytical Studies
ATTITUDES	*Students are able to* meet the challenge of acquiring more complex Japanese language knowledge and skills.

LEVEL 3, LEVEL 4 and LEVEL 5

Work Experience/Research Project/Production

Students are able to strive for accuracy in every aspect of language use in interactive situations, and they demonstrate positive attitudes toward:

- managing time
- achieving goals
- developing a self-concept
- enhancing their personal interests and aptitudes
- exploring opportunities
- facing new situations
- considering the needs of others.

LATIN

This program is intended for beginning students of Latin at the senior high school level and consists of three sequential courses — Latin 10, 20 and 30.

The characteristics of the program include:

1. a set of goals and objectives that reflect the Goals of Basic Education, together with a rationale to support the inclusion of Latin in a school program

2. specification of minimum expectations by the end of Latin 30 for each language skill (listening, speaking, reading and writing) and for cultural understanding

3. specification of linguistic content for each level

4. specification of minimum core content for all students, as well as elective components for enrichment and remediation

5. suggested teaching and learning strategies and evaluation procedures.

A. PHILOSOPHY AND RATIONALE

Young minds need to be extended in their ways of thinking, and the learning of languages other than the mother tongue facilitates that extension. The study of Latin also develops creativity and a world-oriented outlook.

The learning of Latin opens a door to a different way of thinking. Writers of Latin, whether of the Roman era or later, were bound by the structure of their language to different forms of expression than those of English or French writers. The study of ancient civilization provides an important context for understanding contemporary political and social systems. Reading the classical Latin writers reveals to the student the socio-political foundations of Western civilization and its origins in ancient civilization.

Latin as a subject possesses an integrative-functional element; that is, the content characteristics of Latin enable one to apply or transfer the skills and knowledge to other subject areas.

A student who has read works in Latin is better equipped to understand and appreciate many of the historical, sociological or mythological classical allusions found in English and other European literature.

With the *Official Languages Act* and the multiculture policy, there is an increased interest in second language study in Alberta that has indirectly influenced the demand for Latin. Latin is the basis of the Romance languages. Taken before, or along with one or more of these languages, it provides a grammatical and lexical basis that enables the student to learn more economically and efficiently. Latin is also related in structure to the Germanic and Slavic languages.

Latin is the source of more than half of the English language vocabulary through derivatives, the Romance languages and Latin phrases adopted verbatim. The study of Latin can help a student to enrich his or her vocabulary, comprehend new words, improve spelling and understand grammatical structures in all languages related to Latin. Language transfer studies indicate that students who have studied Latin have a distinct advantage over those who have not in the areas of word power and reading skills.

In the area of social studies, a background in the cultural aspect of Latin studies supports the study of concepts such as citizenship, valour, honour and patriotism, as well as the study of civilization and theories in political science. The cultural content of Latin is also related to geography and history.

The study of Latin and Roman civilization is related to art, art history and architecture. It is associated with law, through terminology, the historical perspective and the codification of laws. It is connected to the sciences, through terminology in biology and chemistry. Its grammatical analysis skills are applicable to computer science. Whatever the student's motivation may be, Latin provides him or her with a useful framework for the application of logical thinking and accuracy.

While Latin has been long considered useful to students intent on a career in law or the medical and scientific fields, it may be of even more service to those planning to study literature, classics, languages, archeology, theology, semantics and history.

Latin is rarely used as a spoken language today. This very fact makes it attractive to a student who wishes or needs to study a second language but who has difficulty with the spoken aspect; this would include those students with a hearing or speech handicap or poor auditory memory.

These many specific benefits of the study of Latin may be resolved into one general value: Latin helps to convey to us the message of the past while enhancing our concept of its function in the present.

B. GOALS AND OBJECTIVES

Goals designate the broad, long-range and significant outcomes desired from a program.

Although the following goals may be given varying emphases, they are all identified as appropriate to learning Latin. These goals are intended to enable the student to:

1. read Latin with understanding through knowledge of vocabulary, grammatical structure and stylistic devices

2. learn more about the English language and other Latin-related languages through expansion of vocabulary and structures of thought expression

3. learn about the ancient world and its values, thereby enhancing his or her link and sense of continuity with the past

4. compare and contrast contemporary Western civilization with the past in respect to social, economic and political structures and values, providing an opportunity for the application of critical thinking skills

5. appreciate the contribution of Latin to English language and literature, as well as to languages and literatures that are related to Latin

6. enhance and enrich the use of English and Latin-related languages, particularly as they relate to other subject areas

7. pronounce Latin words correctly.

Minimum Expectations for Skill Development and Cultural Understanding

The following minimum expectations for skill development and cultural understanding are considered to be part of the core, or mandatory, content of the Latin program.

Listening Comprehension

By the end of Latin 30, *the student will have developed the ability to*:

1. distinguish phonetic differences within the Latin sound system
2. distinguish Latin intonation and stress patterns
3. recognize common Latin phrases and classical allusions, when used in English by various speakers
4. understand basic questions, statements and instructions given in the classroom setting
5. distinguish case and tense indicators.

Speaking

By the end of Latin 30, *the student will have developed the ability to*:

1. produce accurately the sounds and stress of classical Latin (long and short vowels, semivowels, consonants and dipthongs)
2. ask basic questions for information, make statements and reply to instructions given in the classroom setting.

Reading

To achieve the primary objective of learning to read and understand Latin, by the end of Latin 30, *the student will have developed the ability to*:

1. read familiar materials silently, with comprehension
2. read recombinations and rearrangements of familiar material silently, with comprehension
3. read material containing some unfamiliar forms and vocabulary items, for general information about Roman history, civilization and mythology
4. read a representative selection of works by classical authors (adapted and original)
5. read a representative selection of readings that survey Latin literature (from the third century B.C. to modern times)
6. read aloud materials (with familiar vocabulary, idiomatic expressions and forms) with comprehension and correct pronunciation.

Writing

To reinforce the primary objective of learning to read and understand Latin, by the end of Latin 30, *the student will have developed the ability to*:

1. produce sentences or phrases that have combinations or variations of given forms, as provided by the material in the textbook or by the teacher.

Cultural Understanding

By the end of Latin 30, *the student will demonstrate an understanding and appreciation of*:

1. the influence of Latin and Roman culture on Western culture in areas such as literature, art, law, and social and political systems
2. the immense contribution of the Latin language and classical mythology to the English language
3. the similarities and differences between Roman civilization and culture and contemporary civilization.

C. CONTENT

Course Outline

Note: The linguistic content and cultural themes within each course level are not arranged in sequential order.

Linguistic Content

Suggested outline for the study of grammar as a basis for reading skills:

Latin 10	Nouns	– first, second, third declensions
	Adjectives	– first, second, third declensions
	Adverbs	– positive degree
	Verbs	– all conjugations – active voice – all tenses of indicative mood – complementary infinitives – commands (imperative active) – *sum*
	Interrogative words, simple questions	
	Pronouns	– first, second, *quis, quid*
	Numerals one to ten	
	Expressions of place	
Latin 20	Nouns	– fourth, fifth declensions
	Adjectives	– comparison (regular and common irregular)
	Adverbs	
	Verbs	– all tenses of all conjugations in passive voice – *possum* and *eo*
	Subordinate clauses	– with indicative mood
	Pronouns	– third person, demonstratives (*hic/ilille*)
	Datives	– with adjectives, verbs, double
	Relative pronoun	
	Ablative absolute	
	Expressions of time	
Latin 30	Infinitives	– present, perfect, future – active and passive
	Indirect statement	
	Participles	
	Deponents and semi-deponents	
	Subjunctives	
	Irregular verbs	– *fero, fio, volo, malo* and *nolo*
	For reading only:	
		– gerunds and gerundives – conditional sentences – indirect questions and commands – verbs of fearing – expressions of purpose – supine

Cultural Themes

The major cultural themes and selected specific topics of the Latin program are to be developed as part of the core content. Additional specific topics related to the themes are elective. The major cultural themes include:

1. the history of ancient Rome
2. civilization
3. classical mythology
4. the legacy of Latin and its influence on modern languages.

Core Components

In summary, the core components consist of:

1. the minimum expectations for skill development and cultural understanding
2. the content specified in the linguistic component
3. major cultural themes
4. specific cultural topics.

Latin 10: Early History of Rome
(the foundation, early kings, first expansions)

Latin 20: Caesar's Time
(history, the Roman army, the people)

Latin 30: Daily Life During the Empire
(the family, the home, education, food, army)

Elective Components

The elective components consist of:

1. additional cultural topics within major cultural themes.

SPANISH LANGUAGE AND CULTURE 10–20–30

★ This interim program was provincially implemented in September 1997. Copies of the interim program of studies are available for viewing and downloading from the Alberta Education web site.

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UKRAINIAN

At the senior high school level, two programs are available for Ukrainian as a second language:

1. a three-year program
2. the senior high portion of a six-year program.

The three-year Ukrainian program begins in Grade 10 and ends in Grade 12. It is designed for those school jurisdictions wishing to offer Ukrainian as a second language at the high school level.

The new six-year program in Ukrainian as a second language begins in Grade 7 and is part of the six-year sequence, Grades 7 to 12. It is designed for school jurisdictions interested in offering an articulated Ukrainian program beginning in Grade 7 and continuing through Grade 12.

The program is intended to increase the effectiveness of second language learning by greater specificity and improved articulation. Continuity from year to year is essential for achieving the objectives of this program.

The characteristics of the program include:

1. a set of objectives that reflect the Goals of Basic Education, together with a rationale to support the inclusion of Ukrainian in a school program
2. specification of minimum expectations for each language skill (listening, speaking, reading and writing) and for cultural understanding by the end of Grade 12
3. specification of performance statements and linguistic content for each of Grades 10 through 12
4. specification of minimum core content for all students, as well as elective components for enrichment and remediation
5. suggested teaching and learning strategies and evaluation procedures.

A. PHILOSOPHY AND RATIONALE

The Ukrainian language and culture have been present in Alberta for nearly a century. Until the late 1950s, however, Ukrainian was generally taught after school hours in evening and Saturday classes. A formal provincial program in Ukrainian as a second language is a relatively new phenomenon. This being the case, it is desirable and necessary to strengthen and improve the guidelines for teachers and administrators in order to provide students with learning experiences that lead to more effective outcomes appropriate to local, provincial, national and international scenes.

Canada is a multicultural society with Ukrainians ranking as a significant minority group whose history, traditions and culture are recognized as distinct in the nation. Among Canada's different peoples and cultures, Ukrainians are identified closely with the development and building of the country. It is well known that Ukrainians played a significant role in settling the West. As the Ukrainian language and culture are recognized as a

prominent facet of the Canadian mosaic, the study of the Ukrainian language is therefore important to the children of the present generation so that they may assume the rightful and natural heritage of their forefathers. For students of non-Ukrainian origin, the study of Ukrainian as a second language may lead to an appreciation and understanding of a culture and language different from their own.

Because Ukrainians have settled in a great number of countries all over the world, Ukrainian has become a *lingua franca*. To illustrate, Ukrainian is the language of 50 million people of the world living in the Ukraine, Canada, the United States, Brazil, Argentina, Western Europe, Great Britain and Australia. The student of Ukrainian will discover that Ukrainian is closely related to other Slavic languages. Since there are almost 300 million people in the world speaking a Slavic language, Ukrainian can become an important key to communication in many parts of the world. Students should, therefore, be given the opportunity and encouragement to acquire Ukrainian as an additional language.

In learning Ukrainian one gains a new awareness and a greater understanding of culture through the realization that there are similarities and differences between Ukrainian- and English-speaking peoples. Awareness that the patterns of living of each group are based on one's environment and experiences will, it is expected, lead to greater open-mindedness, flexibility and readiness to understand and accept others as they are.

Languages are tools that enable the user to elicit and receive information, to express opinions and feelings; in effect, to communicate. They have different ways of leading speakers to focus on the reality that surrounds them. In our multicultural society, knowledge of another language should thus enable an individual to communicate more effectively in a greater variety of situations related to work or leisure activities. The application of language skills may result in a strong sense of personal achievement and satisfaction. Moreover, the study of Ukrainian fosters a sense of cultural identity.

Many of the skills used in learning another language are the same as those used in learning one's first language. Through the learning of Ukrainian, the learner can become conscious of those skills and how they apply to any language learning. In this process, the learner develops the ability to listen for meaningful sounds, to understand different elements of a sentence, and to analyze a message so as to grasp its meaning. Analyzing messages, reconstructing utterances, and applying acquired knowledge to new situations may enhance the development of problem-solving skills. By using the spoken language, one gains a clearer perception of how the language functions, and of what must be said in order to communicate. Through reading and writing in Ukrainian, one becomes more aware of the shared conceptual basis of Ukrainian and English, as well as of the contrastive features of the two languages.

Growing global interdependence is a reality that cannot be overlooked. With widespread mobility, knowledge of more than one language is becoming increasingly valuable: tourists, technicians, business people, civil servants, diplomats, athletes — people from all walks of life — are going abroad more frequently to visit or to work. Students in our schools cannot foresee where they will be called upon to work. Not only the tourist trade but also multinational companies and many government agencies may consider knowledge of more than one language important in obtaining employment in a world where the job market is more competitive.

It is the purpose of this document to outline a curriculum that will help Alberta students to develop the skills necessary to communicate with others who use Ukrainian, and to preserve the Ukrainian language and culture.

B. GOALS AND OBJECTIVES

Goals designate the broad, long-range and significant outcomes desired from a program.

Although the following goals may be given varying emphases, they are identified as those appropriate to learning Ukrainian and are intended to enable the student:

1. to acquire basic communication skills in Ukrainian by:

    1.1 developing the receptive skills of listening, reading and viewing

    1.2 developing the expressive skills of speaking and writing

2. to develop cultural sensitivity and enhance personal development by:

    2.1 becoming more aware of his or her own cultural heritage through exposure to Ukrainian

    2.2 developing a positive attitude toward people who speak another language, through a meaningful exposure to the Ukrainian language and culture

    2.3 developing a greater awareness and appreciation of cultural values and lifestyles in Canada and in other countries

    2.4 becoming aware of and appreciating, through instruction and direct experiences, the valuable contributions of Ukrainian-speaking peoples to civilization

3. to develop originality and creativity in language by:

    3.1 enabling one to apply one's skills to new and meaningful situations

    3.2 enabling one to express one's ideas and feelings

    3.3 enabling one to discover a new dimension to one's personality

4. to acquire additional concepts and generalizations about language and language learning by:

    4.1 recognizing the basic structural similarities and differences between Ukrainian and other languages

    4.2 acquiring some knowledge of the structure and function of languages

    4.3 developing an awareness of regional, social and functional variations of spoken and written Ukrainian

    4.4 developing a conscious knowledge of the skills and strategies used in learning a second language

5. to develop a desire to extend or improve one's proficiency in Ukrainian through further language study, whether for travel, interest, social needs, post-secondary requirements or vocational needs.

Three-year Program — Minimum Expectations for Skill Development and Cultural Understanding

The following minimum expectations for skill development and cultural understanding are considered to be part of the core or mandatory content:

Listening Comprehension

Upon completion of Grade 12, *the student will be able to*:

1. distinguish phonetic differences that affect meaning, such as accent changes and case endings

2. perceive in the intonation and stress patterns used by a speaker to convey intentions, feelings and emotions

3. demonstrate an accurate understanding of familiar questions, statements and instructions that incorporate the basic elements of the program

4. comprehend new combinations of structure and vocabulary of the program, including simple and complex sentences, dialogues and short paragraphs

5. understand a variety of speakers in structured situations

6. understand the general meaning of material containing a limited number of unfamiliar lexical items or readily understood cognates.

Speaking

Upon completion of Grade 12, *the student will be able to*:

1. produce acceptable pronunciation, intonation, stress and euphonic patterns

2. respond orally to cues that require the use of basic linguistic elements of the program

3. ask for information on a specific topic

4. produce a sentence by recombining known elements

5. describe a familiar situation

6. relate a sequence of actions or ideas

7. summarize the main ideas of a familiar situation

8. express one's own ideas and feelings within the range of one's own language experience and areas of interest.

Reading

Upon completion of Grade 12, *the student will be able to*:

1. read aloud new combinations of familiar material and material containing some new semantic elements demonstrating correct sound–symbol correspondence, word groupings, basic intonation patterns and accents

2. read silently with comprehension:

   2.1 familiar material learned orally

   2.2 new combinations and rearrangements of familiar materials

   2.3 material containing some vocabulary whose meaning can be inferred

3. read for information based on themes for which vocabulary has been learned.

Writing

Upon completion of Grade 12, *the student will be able to*:

1. produce new combinations or variations of given elements from sequentially developed exercises

2. respond to given questions based on previously learned material upon reading texts

3. write from dictation sentences containing new combinations of learned written material

4. make required variations (person, number, time) in given sentences

5. write a sequence of sentences from a given outline, from a list of linguistic elements, or from visual and oral cues

6. express oneself in simple, original sentences within the limits of the linguistic content specified in the program.

Cultural Understanding

At the end of Grade 12, *the student will be able to*:

1. relate factual, cultural information that has been learned

2. recognize the significance of simple gestures, facial expressions, intonations and stress patterns used by a speaker to convey intentions, feelings and emotions

3. recognize the connotative meanings of familiar vocabulary

4. speak and write about differences and similarities within Ukrainian culture

5. recognize the current manifestations of Ukrainian culture

6. interpret everyday cultural patterns

7. use common conventions.

Six-year Program — Minimum Expectations for Skill Development and Cultural Understanding: Grades 10, 11 and 12

The minimum expectations for skill development and cultural understanding are considered to be part of the core or mandatory content. The following expectations are generally arranged by order of increasing difficulty.

Listening Comprehension

By the end of Grade 12, *the student will be able to*:

1. distinguish phonetic differences within the Ukrainian sound system

2. demonstrate an understanding of familiar questions, statements and instructions that incorporate the basic elements of the program

3. demonstrate an understanding of new combinations of structures and vocabulary of the program

4. grasp the general meaning of material containing cognates and a limited number of unfamiliar lexical terms

5. understand a variety of speakers, in structured situations

6. perceive in the intonation and stress patterns used by a speaker to convey intentions, feelings and emotions

7. understand the general meaning of material containing some unfamiliar cognates or vocabulary items

8. recognize specific information and ideas

9. demonstrate an understanding of weather reports, newscasts, speeches and stories by answering general questions orally and in writing

10. demonstrate the ability to understand the intent and attitude of a speaker

11. demonstrate the ability to perceive levels of language usage: formal, informal, colloquial, regional

12. discuss a passage by answering questions, by selecting the major ideas, and by citing evidence to support conclusions.

Speaking

By the end of Grade 12, *the student will be able to*:

1. accurately produce Ukrainian sounds, intonation, rhythm, stress patterns, elision and liaison

2. respond orally to cues that require the use of basic linguistic elements of the program

3. produce a sentence by recombining known elements

4. describe a familiar situation

5. relate a sequence of actions or ideas

6. summarize the main ideas of a familiar situation

7. ask for needed information on a specific topic

8. express some personal ideas and feelings, and relate personal experiences within the range of one's own language experience and areas of interest

9. interview someone, and report findings

10. present a summary on a specified topic

11. explain how to do a practical activity, such as cook, assemble, construct, repair or play an instrument, buy or sell something

12. speak on a selected topic

13. exchange ideas in a conversation or discussion.

Reading

By the end of Grade 12, *the student will be able to*:

1. read aloud recombinations of familiar material, demonstrating correct sound–symbol correspondences, word groupings, basic intonation patterns and rhythm

2. read aloud materials containing some new semantic elements demonstrating the ability to apply generalizations about sound–symbol correspondences, word groupings, basic intonation patterns and rhythm

3. read silently with comprehension:

   3.1 familiar material learned orally

   3.2 recombinations and rearrangements of familiar materials

   3.3 material containing cognates, punctuations, contextual clues and a limited number of unfamiliar lexical items

4. read for information, themes for which vocabulary has been learned

5. read for specific information and ideas

6. read for major ideas contained in a short text

7. discuss a passage read by answering questions or by citing evidence to support conclusions

8. summarize orally or in writing the content of what has been read

9. read newspaper and magazine articles for information and for enjoyment.

Writing

By the end of Grade 12, *the student will be able to*:

1. copy variations of sentences and phrases learned orally

2. rearrange words and phrases

3. produce new combinations and phrases learned orally

4. answer given questions in writing

5. write from dictation, sentences of learned written materials

6. express oneself in simple original sentences within the limits of the linguistic content specified in the program

7. make required variations (time, person, number) in given sentences

8. answer questions in writing based on a text read

9. write a sequence of sentences from a given outline, from a list of linguistic elements, or from visual and oral cues

10. write a summary

11. write a social letter

12. write a business letter

13. write a short narrative or descriptive paragraph based on prior reading, oral activity or personal experience.

Cultural Understanding

By the end of Grade 12, *the student will be able to*:

1. relate factual information that has been learned

2. recognize the significance of simple gestures, facial expressions, intonations and stress patterns used by a speaker to convey intentions

3. recognize the connotative meanings of familiar vocabulary

4. recognize the current manifestations of Ukrainian culture

5. interpret everyday cultural patterns

6. use common conventions

7. demonstrate a knowledge of Ukrainian cultures in Canada and in other countries

8. recognize the similarities and differences between these expressions of culture and one's own

9. identify some of the values, attitudes and ideas of the target culture

10. identify some of the contributions made by Ukrainians to Canadian society.

C. CONTENT

Specific skills, objectives and content of each grade level are outlined in the *Six-year Ukrainian Program Curriculum Guide*, 1981 (Grades 7–12) and the *Three-year Ukrainian Program Curriculum Guide*, 1981 (Grades 10–12).

The objectives and content are selected on the basis of categories of language use. Examples are:

1. social conventions
2. identification of persons and things
3. expressing actions
4. expressing location
5. destination
6. describing people and things
7. expressing permission and desire
8. expressing quantity
9. expressing time
10. expressing possession
11. expressing cause and effect
12. specification of persons and objects
13. indirect speech
14. identification of person's nationality.

These language functions are considered to be main categories of verbal communication. In the classroom, each of the above categories may be realized separately or in various combinations. In this program, expected verbal performances and linguistic content are specified for each category.

Performance Statements

The performance statements indicate the minimum that students are expected to do in verbal communication in the second language.

Linguistic Content

The linguistic content identifies the minimum language structures, sentence patterns, changes in word forms and vocabulary that students are expected to acquire in order to engage in verbal communication.

The categories of language use, the performance statements and linguistic content for each grade level, are not arranged in a sequential order, although it is recommended that the specified objectives and content be covered by the end of each grade. It is expected that the content specified in the categories of language use, the skills described in the performance statements, and the minimum expectations will have been mastered by the end of Grade 12.

Suggested Vocabulary

The vocabulary is suggested for development of everyday themes and is intended to complement the vocabulary found in primary learning resources. These lists are an additional source for teacher reference and are considered to be elective.

Cultural Themes

The following cultural themes are to be developed as part of the core content in Grades 10, 11 and 12 (specific topics within each theme are elective):

1. conventions
2. role of the family and community

3. role of education in society
4. role of government in society
5. influence of geography, climate and natural resources on the economic and cultural development of the Ukrainian people living in different countries of the world
6. role of the arts and sciences and their impact on world cultures.

Core Components

In summary, the core components consist of:

1. minimum expectations for skill development and cultural understanding

2. the content specified in the categories of language use

3. the skills and concepts identified in the performance statements

4. the major cultural themes

5. the study of cultures of Ukrainian-speaking peoples in the world.

Elective Components

The elective components consist of:

1. the suggested vocabulary

2. the topics specified for each major cultural theme.

These elective components are found in the appropriate curriculum guide.

SOCIAL SCIENCES

CONTENTS

Social Sciences [general]

Anthropology
- Cultural and Physical Anthropology 30

Economics
- Economics for Consumers 20
- Microeconomics 30
- Macroeconomics 30

Geography
- Local and Canadian Geography 20
- World Geography 30

History
- Western Canadian History 20
- Canadian History 20
- Western World History 30

Philosophy
- Origins of Western Philosophy 20
- Contemporary Western Philosophy 20
- Philosophies of Man 30

Political Science
- Political Thinking 20
- Comparative Government 20
- International Politics 30

Psychology
- Personal Psychology 20
- General Psychology 20
- Experimental Psychology 30

Religious Studies
- Religious Ethics 20
- Religious Meanings 20
- World Religions 30

Sociology
- General Sociology 20
- Sociological Institutions 20
- Applied Sociology 30

SOCIAL SCIENCES

GENERAL INTRODUCTION

RATIONALE

The social sciences 20–30 program is intended to complement the Alberta social studies program by encouraging increased understanding of "man and his world." Courses in this program are distinct from the social studies curriculum in that they focus on the structure, concepts and methodologies of specific social science disciplines. The electives are not intended to provide an alternative to the existing social studies curriculum. Rather, they have been developed to meet diversified student interests, and to add enrichment and in-depth understanding to the scope of the total curriculum.

STRUCTURE

The social sciences 20–30 program is comprised of a series of 3-credit courses. Each course develops several themes appropriate to one of the following disciplines — Anthropology, Economics, Geography, History, Philosophy, Political Science, Psychology, Religious Studies and Sociology. The sequence in which the courses in any particular discipline may be studied is optional.

In structuring the social sciences program a school is free to select those courses that best complement teacher and student interests.

Some faculties will accept two of the 30-level social science options for purposes of university entrance. Counsellors are encouraged to consult university calendars and/or contact pertinent faculties before advising students to include such options in their programs.

OBJECTIVES

The objectives of the social sciences courses are:

1. to develop an insight into the basic concepts of the discipline
2. to develop an insight into specific modes of inquiry and skills unique to a particular discipline
3. to develop an understanding of how knowledge is produced in a particular discipline
4. to provide opportunities to experience the emotive qualities inherent to an interest-motivated approach to the study of a discipline.

ANTHROPOLOGY

CULTURAL AND PHYSICAL ANTHROPOLOGY 30

OBJECTIVES

Anthropology concerns itself with all aspects of human life. As students become more and more concerned with intercultural relationships and understandings, their need for an anthropological perspective increases. *Students* who have studied anthropology at the high school level *should*:

1. demonstrate an understanding of anthropology as the study of the total way of life of human beings
2. demonstrate an understanding of the value of anthropology as a means of improving social and cultural relations
3. demonstrate an understanding of the methods, techniques and tools used by anthropologists.

CONTENT

Theme 1: Introduction to Anthropology

Theme 2: The Examination of Paleolithic-like Lifestyles

Theme 3: The Examination of Mesolithic-like Lifestyles

Theme 4: The Examination of Traditional-state and Empire Societies

Theme 5: Culture Interrelationships and Culture Change

ECONOMICS

OBJECTIVES

Students who have studied economics at the high school level *should*:

1. know that economics is a discipline consisting of a body of knowledge and a method of inquiry
2. understand basic economic concepts and generalizations
3. be able to collect, arrange, process, read and use economic data
4. be able to construct economic models
5. be able to draw conclusions, inferences and generalizations from relevant economic data
6. be able to function well within the economic system.

ECONOMICS FOR CONSUMERS 20

CONTENT

1. Factors that may influence the level of a person's income
2. Factors that may influence the level of a person's expenditures
3. Advantages and disadvantages of credit
4. Influences of inflation as it affects both income and expenditures
5. Conditions that people face when making commitments or expenditures in the consumer or capital goods market

MICROECONOMICS 30
People, Prices and Profits

CONTENT

1. Economics in everyday living
2. How an economic system functions
3. The theory of demand and supply
4. The policies of individual firms
5. The individual and the economy
6. Credit
7. The function of organized labour and collective bargaining
8. Agriculture and economics
9. Pure competition, oligopoly and monopoly
10. Advertising

MACROECONOMICS 30
Markets, Money and Management

CONTENT

1. Introduction to economics
2. Economics as a discipline
3. The functions of an economic system
4. The concepts of specialization and division of labour and the consequences of their application in economics
5. The nature, importance and function of money and banking
6. Inflation and its influences on the economy
7. The use of index numbers in measuring cost of living and other statistical measures
8. GNP and national income as ways of measuring the effectiveness of the economic system
9. The relationship of spending and employment
10. The classical roots of economic principles
11. The economics of government
12. Government controls of business cycles
13. Economics and specialization
14. Income distributions
15. Interdependence in an economy
16. Basic economic theories and systems
17. Economics and developing countries

GEOGRAPHY

OBJECTIVES

The objectives of the courses in geography are that *the student should*:

1. acquire an understanding of the following major organizing concepts in geography: areal association, density, human occupance, pattern, region, scale, spatial distribution, spatial interaction

2. acquire facility in the use of the geographer's mode of inquiry and skills such as the following:

   a. the reading and interpretation of aerial photographs, maps, pictures, tables and graphs, and other written source materials
   b. field work processes of observation and recording

3. have the opportunity to develop positive attitudes in relation to the following topics:

   a. interdependence among peoples
   b. respect for similarities and differences among peoples
   c. clarification of values in respect to other value systems
   d. respect for the scientific method of inquiry
   e. knowledge of multiple causation.

CONTENT

Introductory Unit (to be taken as part of both Local and Canadian Geography 20 and World Geography 30, if necessary).

Skills and Concepts in Geography

1. Map reading and atlas skills
   a. atlas
   b. topographical maps
   c. thematic maps
   d. graphs and diagrams
   e. aerial photography

2. Movement of the earth
   a. rotation and revolution
   b. seasons
   c. climate zones

3. Climate
   a. elements of climate
   b. factors influencing climate

4. World geographic systems
   a. winds
   b. ocean currents
   c. climate
   d. land use
   e. population distribution
   f. relationships

LOCAL AND CANADIAN GEOGRAPHY 20

CONTENT

Theme 1: The Change in Settlement Patterns in the Local Area
- a. the neighbourhood and the city
- b. the city in relation to neighbourhood and settlement patterns
- c. relationship of the urban industrial resources to the rural primary resources
- d. the relationship of systems to the city
- e. the settlement patterns of a particular town or city related to the physical features of the site and the social characteristics of the people

Theme 2: Settlement Patterns in Western Canada
- a. the human occupance of Western Canada
- b. human occupance regions of Western Canada
- c. depth studies of regions

Theme 3: Settlement Patterns in Eastern Canada
- a. the human occupance of Eastern Canada
- b. depth studies of regions
- c. studies of the larger regions in Eastern Canada
- d. population (summation)

WORLD GEOGRAPHY 30

CONTENT

Theme 1: World Patterns of Population and Settlement
- a. the human occupance of Canada
- b. the human occupance of the world
- c. case studies in population and settlement
- d. humankind's settlement types and patterns
- e. cities of the world and world urbanization

Theme 2: World Patterns of Humankind's Use of the Earth
- a. human economics
- b. primitive hunting, fishing, collecting
- c. pastoralism or livestock economy
- d. agriculture of the world
- e. world industry and resources
- f. manufacturing
- g. Japan: case study of industrialization
- h. world transportation and commerce

Theme 3: World Patterns of Physical Elements
- a. the lithosphere
- b. landforms
- c. climate: elements, controls, regions
- d. vegetation; soils

HISTORY

WESTERN CANADIAN HISTORY 20

OBJECTIVES

The objectives of Western Canadian History 20 are:

1. understanding of how the West came to be what it is today: its social, economic, political and religious development
2. knowledge of specific "postholes" that illustrate the basic issues that have defined Western Canadian society in the past and continue to define it today
3. insights into human nature, and how society operates. Francis Bacon said: "histories make men wise"
4. establishment for each student of a personal relationship with his or her own family's past
5. ability to tell succinctly what a book says
6. development of writing ability
7. a genuine appreciation of the contribution made by diverse ethnic and religious groups, and a feeling for what it means to be a citizen in the culturally rich melting pot of Western Canada
8. growth of interest in the practical and aesthetic qualities of the study of history.

CONTENT

1. Overview
2. Indian pioneers
3. Fur trade and exploration
4. Impact of the United States on Western Canada
5. Culture contact
6. Settlement and immigration
7. The Canadian Pacific Railway
8. Responsible government and provincial autonomy
9. Western alienation
10. The social gospel
11. The Depression and western political response
12. The Western Canadian mystique

CANADIAN HISTORY 20

OBJECTIVES

The objectives of Canadian History 20 are:

1. the development of cognitive and social skills that enable the student to deal with historical and contemporary social problems
2. the knowledge of facts, concepts and generalizations pertinent to an understanding of Canadian history.

CONTENT

1. Early foundation to 1815
2. Emergence from colonialism 1815–1849
3. Creation of a nation 1849–1867
4. Nation building 1867–1896
5. A maturing nation 1896–1911
6. A nation in trial
7. The modern nation

WESTERN WORLD HISTORY 30

OBJECTIVES

The objectives of Western World History 30 are that the student will be able:

1. to identify the common characteristics that distinguish each of the following concepts:
   a. fact
   b. inference
   c. hypotheses
   d. frame of reference
   e. analytical questions
   f. relevance
   g. data
   h. inquiry
   i. taxonomy
   j. logical implications
2. to identify and/or provide examples of each of the preceding concepts
3. to apply each of the following principles to unique situations:
   a. historians initiate inquiry by recognizing a problem from data
   b. historians form hypotheses by formulating analytical questions stating hypotheses and remaining aware of the tentative nature of hypotheses
   c. the logical implications of hypotheses are recognized
   d. while data is being gathered, decisions are made on what data will be needed and the relevance of data to the hypotheses
   e. data is analyzed, evaluated and interpreted. Evaluation involves determining the frame of reference of the author of the source and determining the accuracy of statements of fact or inference
   f. the hypothesis is evaluated in light of the data. The hypothesis is modified, if necessary, by rejecting a logical implication unsupported by data, or restating the hypothesis. Generalizations are then stated.

4. to exhibit the following skills:

   a. given a set of unique data, classify the data
   b. given a piece of data, formulate acceptable analytical questions
   c. from analytical questions, formulate hypotheses
   d. given hypotheses relative to familiar data, state the logical implications of the hypotheses
   e. judge the relevance of unique data to unique hypotheses
   f. identify the frame of reference of the author of a unique piece of data
   g. using internal and external criteria, determine the validity of facts and inferences
   h. given data contradictory to the hypothesis, indicate necessary changes in hypotheses.

CONTENT

1. Geographic survey of the Western world
2. The classical heritage
3. The medieval synthesis and the beginnings of national movements
4. Absolutism
5. Science, technology and progress
6. Equality and revolution
7. Nationalism and imperialism

PHILOSOPHY

ORIGINS OF WESTERN PHILOSOPHY 20

OBJECTIVES

The objectives of Origins of Western Philosophy 20 are:

1. to understand the gradual unfolding of Western philosophical thought
2. to appreciate the new approaches and accomplishments of early Western philosophies
3. to analyze the philosophical concepts, and to be aware of their implications
4. to compare and evaluate various early Western philosophical thoughts and systems
5. to apply the presented concepts, and to use them in developing one's own philosophical thinking.

CONTENT

1.* What philosophy is
2.* The need for philosophy
3. Transition from mythological understanding to philosophical reflection
4. Search for an ultimate element
5. Search for a principle of order and harmony
6. The problem of identity and change
7. Shift of interest from physical speculation toward human life
8. Plato's world of ideas
9. The Aristotelian universe

CONTEMPORARY WESTERN PHILOSOPHY 20

OBJECTIVES

The objectives of Contemporary Western Philosophy 20 are:

1. to identify the basic problems of philosophy
2. to appreciate the importance of reason and critical thinking in philosophical inquiry
3. to analyze major contemporary philosophies to determine their position on basic philosophical questions
4. to appreciate a systematic approach to the major philosophical questions
5. to compare major contemporary Western philosophies.

CONTENT

1.* What philosophy is
2.* The need for philosophy
3. The historical roots of contemporary philosophy
4. Systematic approaches to the traditional problems of philosophy
5. Expressions of a major philosophy
6. Analysis of a major philosophy
7. The value of a philosophy as a basis for an individual's philosophy

PHILOSOPHIES OF MAN 30

OBJECTIVES

The objectives of Philosophies of Man 30 are:

1. to develop the process of critical examination
2. to integrate or orient oneself toward the various phases of human experience
3. to open up the wide range of problems and deal with vital questions of human interest
4. to appreciate the attempts of great philosophers to provide coherent and consistent answers to fundamental questions
5. to think about the basic foundations of one's outlook, knowledge and beliefs
6. to understand that "Man has the ability to examine his life; without that he is nothing."

CONTENT

1.* What philosophy is
2.* The need for philosophy
3. The nature of man
4. How free is man
5. Man and man (political philosophy)

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* These two topics appear as a common introduction to each of the 3-credit courses in philosophy. They may be omitted for students who have already taken one of the philosophy courses.

POLITICAL SCIENCE

POLITICAL THINKING 20

OBJECTIVES

The objectives of Political Thinking 20 are:

1. to provide an understanding of the process of political decision making
2. to further an understanding of the democratic process
3. to establish an awareness on the part of the student of different political points of view and to create in the student an element of political sophistication
4. to illustrate the relationship that exists in society between freedom, on the one hand, and responsibility on the other
5. to emphasize the above objectives in terms of their relevance to the Canadian political system.

CONTENT

1. Definition of political science
2. Historical forms of governance
3. The exercising of political power
4. Political/economic philosophies

COMPARATIVE GOVERNMENT 20

OBJECTIVES

The objective of Comparative Government 20 is to compare and contrast the Canadian political process to the system(s) adopted in the United Kingdom, the United States of America and/or the Union of Soviet Socialist Republics.

CONTENT

1. Definition of political science
2. The Canadian constitution, its origins and applications
3. The government of the United Kingdom
4. The government of the United States of America
5. The government of the Union of Soviet Socialist Republics

INTERNATIONAL POLITICS 30

OBJECTIVES

The objective of International Politics 30 is to give the student an understanding of the development and importance of international relations. This understanding is brought about by examining such concepts as balance of power, dynastic marriages, territorial rivalry, ideological rivalry, international peace forums and international economic relations.

CONTENT

1. Definition of political science
2. The nature and evolution of power in international relations
3. Historical forms of international relations
4. The effects of technology on international relations
5. International forums for peace
6. International forces in the economy

PSYCHOLOGY

OBJECTIVES

The objectives of the 3-credit courses in psychology are designed to develop within the student the skills and understandings that make it possible for more effective living in our complex environment. The student's attention will focus on the scientific approach to understanding human behaviour so that he or she may appreciate more fully the reasons that underlie one's own acts and those of one's fellows.

PERSONAL PSYCHOLOGY 20

CONTENT

Theme 1: Introduction to Psychology
- a. definition
- b. the place of psychology among other sciences
- c. what psychology is not
- d. psychology and hypnosis
- e. parapsychology
- f. methods of psychological study

Theme 2: Personality
- a. the development of personality
- b. theories of personality
- c. scientific techniques for measuring personality
- d. projective techniques

Theme 3: Behaviour
- a. development
- b. physical development
- c. motor development
- d. language development
- e. emotional development
- f. social development

Theme 4: Intelligence
- a. the meaning of intelligence
- b. individual tests of intelligence
- c. group tests of intelligence
- d. practical applications of intelligence tests
- e. mental retardation
- f. intellectually gifted children
- g. criticisms of intelligence tests

PERSONAL PSYCHOLOGY 20 (continued)

Theme 5: Heredity and Environment
- a. inherited characteristics
- b. studies of heredity
- c. heredity and maturation
- d. influences of environment before birth
- e. influences of environment after birth
- f. interaction of heredity and environment

Theme 6: Biological Influences on Behaviour
- a. the nervous system
- b. reaction time
- c. the brain
- d. convulsive disorders
- e. glands
- f. emotional behaviour
- g. instincts, or species; specific behaviour
- h. the effect of sleep on behaviour

Theme 7: Understanding Perception
- a. attention
- b. sensation and perception
- c. vision
- d. hearing
- e. other sense fields
- f. sensory deprivation

GENERAL PSYCHOLOGY 20

CONTENT

Theme 1: History of Psychological Schools of Thought
- a. philosophical origins of psychology
- b. beginnings of modern psychology
- c. major approaches to understanding behaviour

Theme 2: Principles of Learning
- a. what is learning?
- b. trial and error learning
- c. classical conditioning
- d. terms related to classical conditioning
- e. operant conditioning
- f. terms related to operant conditioning
- g. operant conditioning and punishment
- h. operant conditioning and programmed learning
- i. learning by insight
- j. controversial areas of learning

Theme 3: How to Learn Efficiently
- a. transfer
- b. other factors in learning efficiently
- c. the progress of learning
- d. remembering
- e. forgetting

Theme 4: The Process of Thinking
- a. basic elements of thinking
- b. concepts
- c. uncritical thinking
- d. creative thinking
- e. imagining
- f. reasoning
- g. computer versus human thinking
- h. applying principles of learning to taking examinations

Theme 5: Facing Frustration and Conflict
- a. frustration and conflict
- b. types of conflict
- c. desirable ways of responding to frustration and conflict
- d. adjustment mechanisms
- e. cognitive dissonance

GENERAL PSYCHOLOGY 20 (continued)

Theme 6: Emotional Problems of Adolescents
- a. inferiority
- b. daydreaming
- c. thrills and thrill-seeking
- d. family conflicts
- e. dating and romantic love
- f. assuming the roles of men and women

Theme 7: Behaviour Disorders and Their Treatment
- a. behaviour disorders in our society
- b. neurotic behaviour
- c. psychosis
- d. functional psychosis
- e. organic psychosis
- f. personality disorders
- g. the treatment of behaviour disorders

Theme 8: Career Opportunities in Psychology
- a. educational psychology
- b. clinical psychology
- c. physiological psychology
- d. industrial psychology
- e. social psychology

EXPERIMENTAL PSYCHOLOGY 30

CONTENT

Theme 1: Experimental Psychology
- a. psychology as an experimental science
- b. psychological research

Theme 2: Statistics
- a. organizing data
- b. normal distribution
- c. percentiles, deciles, quartiles
- d. measures of central tendency
- e. measures of variability
- f. correlation
- g. validity and reliability

Theme 3: Research Methods
- a. research steps
- b. laboratory experimentation

Theme 4: Research Projects
- a. research; implementation of practical applications
- b. project flexibility
- c. evaluation
- d. suggested design

RELIGIOUS STUDIES

OBJECTIVES

The objectives of the courses in religious studies are to provide an opportunity to experience a number of cultural, historical and contemporary issues from a religious point of view, and through the study of religion as a separate discipline to "develop a philosophy based upon values conducive to ethical and moral behaviour and reflected in an understanding of human worth." (Government of Alberta, *Report of the Commission on Educational Planning.*)

RELIGIOUS ETHICS 20

CONTENT

1. Concept of ethics
2. Meaning of religious ethics
3. Ways in which the adolescent attains self-realization
4. How the adolescent works out his or her identity in society
5. How certain specific contemporary issues affect the adolescent

RELIGIOUS MEANINGS 20

CONTENT

1. Humankind has basic needs
2. The need to search for meaning in life
3. Ways in which humankind searches for meaning in life
4. Faith adds a dimension to humankind's quest for meaning
5. Deity is an ultimate concern in whom many have faith
6. Because faith is a growth process, crisis will be encountered
7. Humankind tends to depend upon others in their growth in faith
8. Faith must manifest itself through action

WORLD RELIGIONS 30

CONTENT

1. Meaning of religion
2. Development of religion
3. Faith is the core element of religion
4. Major religions of the world
5. Basic beliefs and practices of the major religions of the world

SOCIOLOGY

OBJECTIVES

The objectives of the courses in sociology are designed to develop within the student a better understanding of group behaviour. This understanding should be based on fact rather than opinion. The sociological perspective focuses on "what is" rather than "what ought to be." Students should be able to analyze occurrences around them objectively. They should feel themselves to be a part of society, understand its influence on their lives, and visualize their roles in societal change.

GENERAL SOCIOLOGY 20

CONTENT

Theme 1:* The Discipline of Sociology
- a. sociology as a field of study
- b. scientific methods of study

Theme 2: Culture
- a. culture
- b. cultural values, norms and sanctions
- c. deviations from cultural norms
- d. culture and personality

Theme 3: Society and Social Class
- a. organization of society
- b. social stratification
- c. social class
- d. changes in status; social mobility

SOCIOLOGICAL INSTITUTIONS 20

CONTENT

Theme 1:* The Discipline of Sociology
- a. sociology as a field of study
- b. scientific methods of study

Theme 2: Institutions
- a. social institutions
- b. the family
- c. the institution of religion
- d. sociology of education

Theme 3: Minorities
- a. minority groups
- b. race and ethnic relations

Theme 4: Influencing Behaviour
- a. social behaviour
- b. public opinion, mass communication and propaganda
- c. social control and deviation

Theme 5: Role and Status
- a. role and status

APPLIED SOCIOLOGY 30

CONTENT

Theme 1:* The Discipline of Sociology
- a. sociology as a field of study
- b. scientific methods of study

Theme 2: Sociology Applied
- a. applied sociology
- b. crime and delinquency
- c. youth rebellion
- d. sociological phenomena

Theme 3: Sociology and the Individual
- a. applied sociology and the individual
- b. determining your goals
- c. your educational analysis
- d. mate choice and marriage

Theme 4: Changes in Culture
- a. social and cultural change
- b. social movements

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* Since each 3-credit course is to be independent and non-sequential, the first theme is repeated. A student need not take it more than once.

SOCIAL STUDIES

CONTENTS

Social Studies 10–20–30

Social Studies 13–23–33

SOCIAL STUDIES 10–20–30

A. PROGRAM RATIONALE AND PHILOSOPHY

Social studies is a school subject that assists students to acquire basic knowledge, skills and positive attitudes needed to be responsible citizens and contributing members of society. The content of social studies draws upon history, geography, economics, other social sciences, and the humanities. The content serves as the context in which important skills and attitudes are developed.

Central to all curricula are the students. The Alberta Social Studies Program takes the following factors into account:

The Nature and Needs of the Learner: The expected learnings are consistent with the social and intellectual maturity of the students.

The Nature and Needs of a Changing Society: The program prepares students for active and responsible participation in a changing world. It seeks to equip students with the knowledge and skills necessary to function in the society in which they must ultimately find their place.

The Nature of Knowledge in Each Subject Area: The program content reflects the vast scope of the disciplines of history, geography, economics and social sciences at a level consistent with the maturity of the students.

The Learning Environment: The program identifies what is to be taught and provides the flexibility for teachers to adapt the program to meet the needs of the learners. It addresses the needs and conditions in schools and the availability, accessibility and variety of learning resources within the school and community.

In our changing society, students will need to be practised at using a variety of skills and strategies. Students will need to be able to acquire knowledge, to interpret and communicate information, and to solve problems and make decisions. In doing all of this, students require a wide range of critical and creative thinking skills and strategies that they can apply to a variety of situations. Therefore, the concept of learners as receivers of information should be replaced with a view of learners as self-motivated, self-directed problem solvers and decision makers who are developing the skills necessary for learning and who develop a sense of self-worth and confidence in their ability to participate in a changing society.

In order to accommodate students with a wide range of abilities, needs, interests and aspirations, two sequences for the Senior High School Social Studies Program have been developed. Although the content, skills and attitudes are similar for both sequences, the expectations for Social Studies 10–20–30 are more challenging, particularly in the depth of concept development, the level of critical and creative thinking, and inquiry skill development. The nature of the student learning resources that are approved for each sequence differ.

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B. GENERAL LEARNER EXPECTATIONS

RESPONSIBLE CITIZENSHIP

Responsible citizenship is the ultimate goal of social studies. Basic to this goal is the development of critical thinking. The "responsible citizen" is one who is knowledgeable, purposeful and makes responsible choices. Responsible citizenship includes:

- understanding the role, rights and responsibilities of a citizen in a democratic society and a citizen in the global community
- participating constructively in the democratic process by making rational decisions
- respecting the dignity and worth of self and others.

Citizenship education is based on an understanding of history, geography, economics, other social sciences and the humanities as they affect the Canadian community and the world. However, knowledge is changing rapidly. These changes bring into focus the need to provide the knowledge and skills necessary to meet the challenges of, and keep pace with, an ever-changing world. Therefore, emphasis is placed on learning those social studies facts, concepts, generalizations and skills that are useful for lifelong learning and responsible citizenship.

Social studies is organized around knowledge, skill and attitude objectives. These objectives should not be addressed separately or sequentially. The achievement of any one objective is directly related to the achievement of another; hence, they should be pursued simultaneously. The responsible citizen uses the knowledge, skills and attitudes acquired from the school, the family and the community.

In order to understand why people act the way they do, one has to examine the underlying reasons for their actions, including their values. Development of understanding of values (identification, definitions, descriptions) is incorporated in the knowledge objectives, and development of competencies (value analysis, decision making) is incorporated in the skill objectives.

KNOWLEDGE OBJECTIVES

To be a responsible citizen, one needs to be well-informed about the past as well as the present, and to be prepared for the future by drawing from history and the social sciences disciplines. The knowledge objectives take into account the history of our community, the nature of a democratic society, an understanding of the nature of man, and an understanding of our changing social, political, technological and economic environments.

Knowledge objectives for social studies topics are organized through generalizations and key understandings, concepts and related facts.

- Generalizations are rules or principles that show relationships among two or more concepts.
- Key understandings are statements of major understandings related to the content of the unit.
- Concepts are ideas or meanings represented by words, terms or other symbols that stand for a class or group of things.
- Facts are parts of information that apply to specific situations; for example, specific statements about people, places, events or ideas.

SKILL OBJECTIVES

Skills are taught best in the context of use rather than in isolation. While skill objectives are grouped into categories for organizational purposes, some of the skills may fit into more than one category. There is a wide variety of thinking skills essential to social studies. These skills are not intended to be developed separately or sequentially and are intertwined with the knowledge and attitude components. Skill objectives for social studies are grouped into the following categories:

Process Skills	– skills that help one acquire, evaluate and use information and ideas

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Communication Skills	– skills that help one express and present information and ideas
Participation Skills	– skills that help one interact with others

Inquiry Strategies

Inquiry strategies help one answer questions, solve problems and make decisions, using process, communication and participation skills. Thinking skills are developed by providing students with many experiences, using strategies, such as problem solving and decision making. The intent is to provide many opportunities within a topic/grade to use problem solving and/or decision making so that the students learn the strategies and then are able to transfer the skills to their own lives. Each topic includes questions that range from those that have an answer based on the available evidence, to those that are issues that need to be resolved. A problem may be defined as any situation for which a solution is desired. An issue may be defined as a matter of interest about which there is significant disagreement. The disagreement can involve matters of fact, meaning or values.

Each topic includes a section entitled Issues and Questions for Inquiry. These sections are not intended to be exclusive. The success of inquiry is enhanced by selecting questions and issues related to the topic that are concrete, relevant, meaningful and of interest to students. Issues and questions can be teacher- or student-generated.

Issues and questions may be investigated, using different strategies. Critical thinking and creative thinking may be encouraged by using a variety of inquiry strategies, such as the problem-solving, decision-making and inquiry process models outlined below. Inquiry calls for choosing and blending strategies. Sometimes, a step-by-step approach may be best. At other times, a more flexible approach may be used. The following strategies can be expanded, modified or combined to suit specific topics, disciplinary emphases, resources and student maturity. Problem solving is a strategy of using a variety of skills to answer a question or solve a problem (who, why, what, where, when, how). Decision making is a strategy that uses values and a variety of skills to determine a solution to a problem/issue that involves a choice (should, how should, to what extent should) and that requires a decision for action. Large issues requiring a policy decision may be addressed through an inquiry strategy. The strategies provided in curriculum documents vary from elementary through secondary levels.

A Model for Answering Questions or Solving Problems

- Define a question/problem
- Develop questions or hypotheses to guide research
- Gather, organize and interpret information
- Develop a conclusion/ solution

A Model for Making Decisions

- Identify an issue
- Identify possible alternatives
- Devise a plan for research
- Gather, organize and interpret information
- Evaluate the alternatives, using collected information
- Make a decision; plan or take action consistent with the decision, if desirable and feasible
- Evaluate the action plan and decision-making process

A Model for the Inquiry Process

- Identify and focus on the issue
- Establish research questions and procedures
- Gather and organize data
- Analyze and evaluate data
- Synthesize data
- Resolve the issue
- Apply the decision, or postpone taking action
- Evaluate the decision, the process, and, where pertinent the action

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ATTITUDE OBJECTIVES

The attitude objectives describe a way of thinking, feeling or acting and are developed through a variety of learning experiences that encompass knowledge and skill objectives. These experiences include participation in specific activities, the development of positive attitudes toward one another, and learning in an atmosphere of free and open inquiry. Attitude objectives should receive continuous and informal evaluation.

The development of the positive attitudes needed for responsible citizenship is a gradual and ongoing process. The attitude objectives for social studies, which students should develop, include:

- positive attitudes about learning
- positive and realistic attitudes about one's self
- attitudes of respect, tolerance and understanding toward individuals, groups and cultures in one's community and in other communities: local, regional, national, global
- positive attitudes about democracy, including an appreciation of the rights, privileges and responsibilities of citizenship
- an attitude of responsibility toward the environment and community: local, regional, national, global.

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C. SPECIFIC LEARNER EXPECTATIONS

The **specific** learner expectations in Social Studies 10, 20 and 30 are organized into knowledge, skill and attitude objectives. These objectives will be integrated into appropriate classroom experiences (exercises and activities) for learners. The **required** component comprises 80% of the program and is represented by topics and statements of objectives that follow. The required component contains the knowledge, skills and attitudes that all students should be expected to acquire. The **elective** component should occupy 20% of the program. The elective component provides enrichment and remediation consistent with the content and objectives of the required component and provides opportunities to adapt or enhance instruction to meet the diverse needs and abilities of students.

The study of **current affairs** adds considerably to the relevance, interest and immediacy of the Alberta Social Studies Program. It is expected that current affairs will be handled as inclusions and extensions of curricular objectives, not as a separate topic isolated from the program. Examination of events or issues of significant local, national or international importance is encouraged, provided a balanced approach to the goals of responsible citizenship is employed and the prescribed objectives of the course are met.

Evaluation, within the Alberta Social Studies Curriculum, is the process of collecting, processing, interpreting and judging program objectives, teaching strategies, student achievement and instructional resources. Evaluation is important during all phases of planning and learning. It should begin with an assessment of student needs, and include consideration of ways that basic resources and support materials can be used to improve learning. Ongoing evaluation determines how well students are achieving prescribed objectives and permits the planning of specific learning experiences. Evaluation should assess the degree of overall success in meeting learning expectations in the program including knowledge, skill and attitude objectives. Knowledge and skill objectives should have equal weight in the evaluation used to calculate grades. Assessment of attitude objectives should not be used in calculating grades.

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SOCIAL STUDIES 10

CANADA IN THE MODERN WORLD
Topic A: Challenges for Canada: The 20th Century and Today

DESCRIPTION

Students will acquire an understanding of forces and events that have influenced the development of Canada and are shaping the lives of Canadians today. This study will focus on the achievement and maintenance of Canada's sovereignty, the effects of regionalism and the development of a national identity.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- assess the action required to maintain Canadian sovereignty in an interdependent world
- interpret the long-term effects of regionalism on Canada
- assess the importance of Canada developing a strong national identity.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- To what extent should Canada maintain her sovereignty?
- Should Canada continue to be a part of various alliances?
- Should Canadians pursue a strong national identity?

Examples of Questions

- What is the Canadian identity?
- How does bilingualism and multiculturalism affect Canada?
- How does regionalism affect Canadian sovereignty?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: SOVEREIGNTY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **geographic factors influence a nation's sovereignty**	sovereignty	Briefly review Canada's geographic location in the world: • boundaries • trade and transport links to the world
b. **the achievement of sovereignty has been a developmental process shaped by internal and external forces**	independence nationhood nation–state national identity	Examine historical and current involvements that contribute to Canadian independence: • Canada's role in World War I – aims and contributions – consequences • attaining independence – *Treaty of Versailles* – League of Nations – *Statute of Westminster*, 1931 – Newfoundland, 1949 – the *Constitution Act*, 1982

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: SOVEREIGNTY (continued)		
c. **there are benefits and costs attached to independence/sovereignty**	intervention international relations	Briefly examine Canada's efforts to maintain security: • Canada's role in World War II – contributions • Canada's role in the Cold War • current defence policy
d. **a nation's foreign policy must be balanced between its interests and the interests of other nations**	foreign policy middle power	Briefly examine Canada's foreign policy: • Department of Foreign Affairs and International Trade • aims and objectives of Canada's foreign policy
e. **the consequences of foreign policy can result in conflict or cooperation with other nations**	global community alliances conflict cooperation collective security	Briefly examine Canada's involvement in the global community with attention to: • Canada and the United Nations: – examples of Canadian involvement in selected UN agencies – peacekeeping activities; e.g., Suez crisis, Bosnia – military actions/peace making; e.g., Korea, Gulf War (Iraq–Kuwait) • Canada/United States of America relations: – defence agreements; e.g., NORAD – boundary disputes (choose one example—Arctic, Northwest Passage, Fisheries) – trade; e.g., NAFTA – environment (choose one example—acid rain, water pollution) • Canada and the Pacific Rim: – location – markets/trade – current initiatives – future importance • Canada and Europe: – joint defence; e.g., NATO, G7/G8 – trade and the European Union

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: SOVEREIGNTY (continued)		
		• Canada and other international organizations; e.g.: – Commonwealth – La Francophonie – OAS • Canada and the developing world: – CIDA and selected examples of non-governmental organizations • Canada and global concerns (select several examples for discussion): – GATT/WTO – trade – immigration policy – environment – aid
THEME II: REGIONALISM		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **Canada is composed of geographic regions with diverse political, economic and cultural interests**	regional diversity pluralism	Examine regions of Canada by outlining the: • political, economic and cultural composition of Canada
b. **Canada's political, economic and social fabric is influenced by geographic factors**	regional disparity	Identify the factors that lead to the power and influence of various regions
c. **regional differences both strengthen and challenge Canadian unity**	national unity regional identity separatism alienation	Select at least two examples of regional interests from the following: • regionally-based political parties • Quiet Revolution • Quebec separatism • western alienation; e.g., National Energy Policy • northern development • Atlantic fisheries • West Coast and Pacific Rim

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: REGIONALISM (continued)		
d. **regional differences are accommodated in various ways**	federalism equalization	Examine Canada's constitutional structure and federal/provincial relations: • the *Constitution Act*, 1982 • First Ministers' Conferences • equalization policies • negotiated agreements between federal–provincial levels of governments; e.g., Meech Lake Accord, Charlottetown Accord • Creation of Nunavut
THEME III: IDENTITY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **Canadians identify with community, region and nation**	Canadian identity	Examine how others perceive Canadians: • reputation on the world scene – honouring commitments; e.g., involvement in UN peacekeeping duties
b. **the Canadian identity is shaped by our values, attitudes and cultures as they have emerged from our history and geography**	nationalism	Examine the perception we have of ourselves: • symbols of nationalism • forces of nationalism (positive and negative) • self-concept – culture – sports • values; e.g., pluralism – attitudes (respect for others, respect for ourselves)

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: IDENTITY (continued)		
c. **bilingualism and multiculturalism are fundamental to the Canadian identity**	bilingualism multiculturalism	Briefly review why Canada is a bilingual and multicultural country by referring to our historical background in order to understand our official policies: • Aboriginal peoples • two founding nations • other cultural groups • bilingual policies • multicultural policies
d. **interaction among groups influences one's identity**	cultural identity	Examine examples of interaction with others in order to understand how they shape one's cultural identity: • legitimacy of self • majority–minority status • assimilation, cultural maintenance, cultural promotion

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic B or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **acquire information from print and nonprint resources**
- **record and organize information in note form**
- **analyze and evaluate information, including detecting bias and distinguishing fact from opinion**
- **interpret and summarize materials**.

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **express and defend ideas in written form**
- **present ideas through visual/multimedia materials**
- **debate issues effectively**
- **report on research results**.

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **work at individual tasks in a group situation**
- **work together in proposing and discussing alternative solutions to issues**
- **cooperate in decision making**.

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions, using process, communication and participation skills.

Students will be expected to develop the ability to:

- **apply critical and creative thinking skills in problem solving and decision making**
- **develop the ability to propose and discuss alternative solutions to issues**
- **develop the skills necessary for composing an argumentative essay**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues**.

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **respect for and an appreciation of the uniqueness of Canada**
- **an appreciation of our evolving Canadian heritage**
- **openness to new ideas and opinions about the nature of Canadian society**
- **respect for the right of all Canadian citizens to express alternative points of view**
- **sensitivity to what being Canadian means to different people in different regions of Canada**
- **preference for peaceful resolution of conflict in personal relations and in society as a whole**
- **respect for the many cultural groups in Canada**
- **continuing interest in national, political, social and cultural affairs in Canada**
- **an appreciation of Canada's role as a nation in an interdependent world**.

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CANADA IN THE MODERN WORLD
Topic B: Citizenship in Canada

DESCRIPTION

Responsible citizenship requires an understanding of the structure and function of government, as well as a willingness to exercise the rights and duties of citizenship in a changing Canadian society. Citizenship in a democratic country like Canada is based upon the assumption that people will be actively involved in decisions affecting the community and in protecting and respecting basic human rights.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- examine the process whereby decisions affecting themselves and society are made
- design and evaluate alternative methods of providing for the protection of human rights in society
- examine how questions that involve the needs of the individual and the needs of the state are resolved.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- To what extent should elected representatives represent the views of their constituents or themselves?
- Should an individual be required to participate in political decision making?
- To what extent should Canada pursue a leadership role in working for the protection of human rights?

Examples of Questions

- How can citizens influence decision making by governments in Canada?
- What responsibilities does the individual have in Canadian society?
- How are human rights protected in Canada?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICS AND GOVERNMENT		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **politics are a feature of everyday life**	decision making organization	Identify examples of consensus, majority rule, influence, negotiation and compromise at school, community, provincial and national levels (laws, services, etc.)
b. **the structure and functions of government in Canada are important**	democracy federalism constitution	Examine parliamentary democracy in Canada including the following: • levels of government – federal – provincial – municipal • constitution – *Constitution Act*, 1867 (formerly known as the *British North America Act* [B.N.A] 1867) – majority and minority rights

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICS AND GOVERNMENT (continued)		
	representative democracy responsible government	– unwritten constitution – the *Constitution Act*, 1982 – party system – elections – constituency – civil service
	division of powers	• functions of government – executive function – legislative function – judicial function
	constitutional monarchy parliamentary system	• role of the – Monarch – Governor General – Prime Minister – Cabinet – Senate – House of Commons – Lieutenant-Governor – Premier – Legislative Assembly – Supreme Court
c. **the political processes are influenced by a variety of groups in the community**	mass media	Examine how television and other media are used to create images, communicate demands, disseminate policies and ideas
	interest groups	Select examples of how interest groups lobby for change; e.g.: • farm groups • consumer groups • environmental groups

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: CITIZEN PARTICIPATION		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **the degree of citizen participation and the exercise of an individual's political power and responsibilities are influenced by a variety of factors**	power	Select an example from each factor for discussion: • demographic factors – population distribution and location – urban – rural • socioeconomic factors – income by region – education – occupation – wealth • cultural factors – historical – linguistic – ethnic groups – gender • geographical factors – location – resources
b. **the citizen has a role in the political process**	participation	Briefly examine citizens' participation in the political process: • voting • campaigning • joining parties • petitioning • lobbying • demonstrating • letter writing
c. **political differences are resolved through a variety of approaches**	democratic process majority and minority rights negotiation and compromise	Identify ways of resolving differences: • legal actions • federal/provincial conferences • royal commissions • arbitration • elections • plebiscite • referendum

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: RIGHTS AND RESPONSIBILITIES		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **rights and responsibilities are associated with citizenship**	rights freedoms justice equality	Examine rights (individual and collective) in Canadian society: • human • civil • legal • minority • economic • cultural • language • political
	responsibilities	Examine responsibilities in Canadian society: • political – franchise • legal – jury duty • moral – respect for the rights of others • social – participating in community activities; e.g., volunteering
b. **there are basic human rights that need to be protected**	human rights discrimination prejudice	Develop an understanding of human rights and the need to protect them by briefly examining the following: • *Universal Declaration of Human Rights* • organizations dedicated to the protection of human rights; e.g., Amnesty International, Red Cross • examples of situations where human rights were not protected: – Canada; e.g., Aboriginal peoples, War time internment (Japanese Canadians, Ukrainian Canadians, Italian Canadians, German Canadians), Women, Children – International; e.g., Holocaust

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: RIGHTS AND RESPONSIBILITIES (continued)		
c. **there are various means that help to protect and preserve rights in Canada**	entrenchment of rights safeguarding rights	Explain how the following help to protect human rights: • *Canadian Charter of Rights and Freedoms*, 1982 • Aboriginal Rights • *Official Languages Act* • *Alberta Human Rights, Citizenship and Multicultural Act*, 1996 • human rights commissions • ombudsmen • courts • media

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic A or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **identify and use relevant information from print and nonprint sources**
- **distinguish between fact and opinion**
- **analyze a variety of alternative positions on a problem or an issue**
- **recognize underlying assumptions on an issue**.

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **defend a position in a short, written assignment**
- **convey information and express ideas, using a visual format**
- **express themselves effectively in an oral presentation**
- **present ideas effectively in class discussion**.

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **interact effectively with others in a variety of group settings**
- **participate in group decision making**
- **choose appropriate strategies for bringing about change in society**.

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions using process, communication and participation skills.

Students will be expected to develop the ability to:

- **develop further the creative and critical thinking skills necessary for responsible citizenship**
- **develop the ability to consider alternatives, make decisions and substantiate choices**
- **examine the processes whereby decisions affecting themselves and society are made**
- **propose and evaluate alternative decision-making models**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues**.

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation of the rights and responsibilities inherent in the democratic way of life**
- **a willingness to accept responsibility for the consequences of one's actions**
- **an appreciation of and a respect for the rights of others**
- **and value peaceful resolution of conflict**
- **a respect for the rights of others to hold opinions different from one's own**
- **an appreciation of the fact that citizenship involves participation in the community and the nation**.

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SOCIAL STUDIES 20

THE GROWTH OF THE GLOBAL PERSPECTIVE
Topic A: Development and Interaction of Nations: Nineteenth Century Europe

DESCRIPTION

The modern world has been influenced by major ideas and forces that have emerged from the nineteenth century European experience. Students will examine nationalism, industrialization, imperialism and international rivalries and their effect on the development and interaction of nations.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- identify underlying values that helped shape ideas and influence events in the European experience
- analyze why certain ideologies developed in the nineteenth century
- assess the influence of selected events and ideas of the nineteenth century on the twentieth century
- compare and contrast examples of nationalism from the nineteenth century with the nature and role of nationalism today.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- To what extent should governments encourage nationalistic feelings among their people?
- To what extent should nations place their interests above the interests of other nations?
- Should governments control the spread of ideologies within their borders?

Examples of Questions

- Why did revolution occur in France?
- How did the various segments of a particular society adjust to change?
- How did industrialization contribute to the rise of nationalism and imperialism?
- How did the Industrial Revolution contribute to the rise of new ideologies?
- How did quality of life change as a result of industrialization?
- Why did World War I occur?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives.** The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: NATIONALISM		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **the emergence of new ideas and forces resulted in changes within society**	revolution	Examine ideas and forces that contributed to the French Revolution: • intellectual • political • economic • social
	egalitarianism individualism	Identify changes to French society: • individual rights • structure of society
b. **a new form of nationalism emerged during the French Revolution**	nationalism	Examine how this new form of nationalism contributed to the evolution of the modern nation–state: • symbols of nationalism

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: NATIONALISM (continued)		
c. **the French Revolution led to the spread of revolutionary ideas throughout Europe**	liberalism	Examine the changes brought about by revolutionary forces and Napoleon: • carrying the ideas of the revolution abroad • centralization of the nation–state
d. **the revolutionary changes of the Napoleonic period resulted in a conservative reaction**	conservatism legitimacy	Illustrate the changes brought about by the Congress of Vienna: • conservative reaction • reaction to nationalism
e. **nationalism continued as a force of change in European society**	change	Refer to one or two examples of nationalistic movements; e.g.: • Italy • Germany
THEME II: INDUSTRIAL-IZATION AND IDEOLOGIES		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **industrialization resulted in changes in society**	industrialization urbanization	Describe changes in methods of production: • agricultural revolution • domestic to factory production • subsistence to surplus production Briefly examine the changes brought about by industrialization: • political changes – Fabian Society – rise of Labour parties • social changes – urbanization – impact on the family – role of women – rise of the middle class – rise of the working class – universal education

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: INDUSTRIAL-IZATION AND IDEOLOGIES (continued)		• cultural changes as illustrated through selected examples from at least one of the following areas: – literature – art – music – science – religion
b. **many modern political and economic ideas and ideologies developed in nineteenth century Europe**	capitalism conservatism liberalism socialism communism	Briefly examine ideological changes and ideas as advanced by: • Adam Smith • Edmund Burke • John Stuart Mill • Robert Owen • Karl Marx • Others
THEME III: IMPERIALISM		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **nations engage in imperialism for a variety of motives**	imperialism	Briefly examine the reasons for imperialism: • economic • political • social • cultural • humanitarian • religious
b. **nations expanded their empires**	colonialism spheres of influence protectorate	Refer to examples of European imperialism on a global scale and the impact of imperialism: • on colonies – economic – political • on the imperial powers – economic – political

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: IMPERIALISM (continued)		
c. **the expansion of empires by European nations led to cultural diffusion**	cultural diffusion	Briefly explain the diffusion of European culture throughout the world
d. **imperialist powers both competed and cooperated**	competition	Identify examples of conflict and cooperation among the imperialist powers: • conflict; e.g.: – Fashoda incident – Moroccan crisis – the Middle East – the Balkans • agreements; e.g.: – Berlin Conference – partition of China
THEME IV: INTERNATIONAL CONFLICT		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **the pursuit of national interests at the expense of other nations may result in international conflict**	national interest balance of power militarism alliances	Examine the causes of World War I: • emergence of new nations – Italy – Germany • competing foreign policies • imperial rivalries • arms race • nationalistic fervour – Balkans • alliance system • diplomatic errors
b. **warfare leads to change**	total war peace treaties	Briefly examine the "Great War" to show change: • strategies and objectives of the competing powers • technological changes • Wilson's Fourteen Points • conscription Examine peace treaties; e.g.: • Treaty of Brest-Litovsk • Treaty of Versailles

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic B or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **summarize information from a variety of print and nonprint sources**
- **distinguish among different points of view**
- **make decisions and defend their choice**.

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **establish a thesis or take a position, and defend it in a well-written essay**
- **present ideas effectively in class debate**
- **convey information and express ideas, using timelines, charts and concept maps**.

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **interact effectively with others in a variety of group settings**
- **participate in group decision making**.

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions using process, communication and participation skills.

Students will be expected to develop the ability to:

- **use creative and critical thinking skills in problem-solving and decision-making strategies**
- **consider alternatives, make decisions and substantiate choices**
- **critically examine processes and changes that have affected society**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues**.

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation of the influence of ideas from the past on society**
- **an awareness of different points of view on issues and episodes in the human experience**
- **respect for the right of others to hold a different point of view**
- **an appreciation of the need to understand the background to events and issues.**

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THE GROWTH OF THE GLOBAL PERSPECTIVE

Topic B: Interdependence in the Global Environment

DESCRIPTION

Economic growth and development have led to increased global interdependence. A responsible world citizen needs to be aware of this interdependence and its effect on quality of life. Students will examine, on a global scale, diversity, development, quality of life and alternative futures. This study will include an understanding of different perspectives on global issues.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- analyze examples of global interaction
- evaluate various perspectives on global questions and issues
- evaluate the effect of economic development and technological advancement on quality of life
- present alternative solutions to selected issues.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- Should individuals be concerned about quality of life in other parts of the world?
- Should developed countries set the standard for quality of life?
- To what extent should environmental concerns restrict economic development?
- Should economic growth and development be a primary goal for all nations?
- To what extent should the world be optimistic about its future?

Examples of Questions

- What is the relationship between global interdependence and economic development?
- What constitutes quality of life?
- What are the consequences of economic development on the environment?
- How will proposed solutions on a particular issue affect quality of life in the future?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: GLOBAL DIVERSITY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **diversity and disparity exist in the modern world**	diversity disparity	Illustrate diversity and disparity through a brief overview of world geography: • geographic regions • political alignments • economic zones • cultural/ethnic groups
b. **nations are interdependent**	interdependence interaction	Introduce the concept of interdependence among nations; e.g.: • trade • technology • markets • communications • migration • transportation

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: GLOBAL DIVERSITY (continued)		
c. **national interests affect international relationships**	national interests	Identify factors that affect international relationships, such as: • competition for markets and resources • ideologies • pressure and prestige • tied aid • defensive alliances
THEME II: ECONOMIC DEVELOPMENT AND INTERDEPENDENCE		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **there are factors that affect economic development**	economic development	Examine how the following factors influence economic development: • geography • capital • resources • technology • culture • markets • politics • decision making – role of tradition – role of new ideas – costs/benefits analysis • impact of imperalism
b. **economic growth and interactions have increased global interdependence**	economic independence economic interdependence	Select examples from the following areas to illustrate international interdependence: • food • energy • minerals • manufactured goods • multinational/transnational corporations • financial institutions • foreign debt

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: ECONOMIC DEVELOPMENT AND INTERDEPENDENCE (continued)		
c. **countries approach economic expansion in different ways**	economic growth developing nations foreign assistance	Use case studies of economic development to illustrate various approaches: • examples should include successful and unsuccessful approaches
d. **development is a complex issue influenced by local and international factors**		Identify those factors that contributed to the success or failure in each case study above. Consider how the approaches might work in other situations
THEME III: QUALITY OF LIFE		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **quality of life is composed of a variety of factors**	quality of life	Explain quality of life by examining: • economics – standard of living – basic material needs – industrial development – technological development • culture – personal/societal views – cultural perspectives – spiritual beliefs – tradition/change • human rights considerations – basic human rights – individual rights – collective rights
b. **quality of life is defined from different perspectives**	perspectives consumerism	• Compare the emphasis on technological advancement and economic growth with at least one other perspective

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: QUALITY OF LIFE (continued)		
c. **quality of life is increasingly affected by issues of global concern**	environmentalism	Choose several examples and study their impact on human populations: • deforestation • desertification • pollution – acid rain – oceans – nuclear and oil – waste disposal • irrigation – fresh water – effect on land • atmosphere • greenhouse effect • energy depletion
THEME IV: ALTERNATIVE FUTURES: POSSIBILITIES FOR CHANGE		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **there are issues of common global concern**	equity justice ecological balance	Study at least one issue of global concern in the following areas: • food sources and distribution • resource consumption • energy sources • spread of disease • armed conflict • demographic pressures • distribution of wealth
b. **solutions to global concerns often require international dialogue**	cooperation humanitarianism	Identify opportunities for international dialogue and cooperation: • United Nations' agencies and resolutions • international law • trade agreements • worldwide conferences • non-governmental organizations

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME IV: ALTERNATIVE FUTURES: POSSIBILITIES FOR CHANGE (continued)		
c. **there are potential solutions to global concerns**	sustainable development	Study several examples to illustrate solutions to global problems; e.g.: • consumer awareness • education • new food sources • transportation/communications • alternative energy sources • waste management • medical advances • atmospheric regulations • appropriate technology • volunteerism • social action

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic A or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **summarize materials after listening to and observing presentations**
- **interpret and use information from maps, graphs, charts and tables**
- **identify appropriate information and ideas as evidence to support a point of view**
- **develop and evaluate proposed solutions.**

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **use comparisons and examples in a written presentation**
- **present information effectively in a group forum**
- **convey information by producing illustrations of proposed solutions**
- **use quotes and references to provide support for their views (footnotes, bibliographies).**

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **participate in an informed way in discussions on global issues that affect society**
- **resolve differences of opinion by debating reasonably and rationally**
- **work effectively with others in a variety of group settings.**

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions using process, communication and participation skills.

Students will be expected to develop the ability to:

- **consider alternative perspectives, make decisions and substantiate choices regarding global issues**
- **examine the processes whereby decisions affecting themselves and global society are made**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues about interdependence in the global environment**
- **evaluate alternative solutions on global issues.**

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation of the diversity that exists in the world**
- **an appreciation that different perspectives exist on quality of life**
- **an awareness and appreciation of the interdependent nature of the world**
- **a willingness to consider a variety of perspectives on global issues and questions**.

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SOCIAL STUDIES 30

THE CONTEMPORARY WORLD
Topic A: Political and Economic Systems

DESCRIPTION

The twentieth century has been dominated by interactions among nations. These nations are organized into different political and economic systems. In order to better-understand the contemporary world, students will critically examine the underlying theories and principles of these systems. Students will also develop an understanding of the main features of political and economic systems and the circumstances under which political and economic systems are developed, challenged and changed in practice. Students should focus on individual and group roles in various political and economic systems and the appropriate balance between the collective good and individual interests.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- analyze and compare features and underlying principles of political and economic systems
- assess why political and economic systems differ in theory and practice
- defend their choice of the most desirable and effective features of selected political and economic systems
- suggest changes that political and economic systems could incorporate to better serve the needs and interests of individuals and society.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry. Issues and questions should be selected in a manner that covers both the political and economic components of the topic.

Examples of Issues

- To what extent should political decision making be restricted to a particular group in society?
- To what extent should political and economic systems emphasize the collective good or individual interests?
- Should a government intervene in an economic system to protect the interests of society?
- To what extent should minority rights be protected in society? Should there be limits on the rights of the majority?

Examples of Questions

- How are the rights and responsibilities of the individual provided for in various political and economic systems?
- What features of the Canadian political and economic system allow individuals to participate in decision making?
- What similarities and differences exist between ideological theory and practice in various political and economic systems?
- How do political and economic systems adapt to meet the challenges of changing circumstances?
- In what ways does the Canadian government intervene in the Canadian economic system?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICAL AND ECONOMIC SYSTEMS IN THEORY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **ideologies contain beliefs and ideas about human nature and are used to explain and justify political and economic systems**	ideology individualism collectivism	Identify the principle features of: • liberalism • conservatism • socialism • capitalism • fascism • communism • anarchism

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICAL AND ECONOMIC SYSTEMS IN THEORY (continued)		
b. **political systems are organized to allocate political power that involves the authority to make and to implement decisions in society**	power decision making	Examine the role of the following in the allocation of power and the organization and operation of political systems: • constitution – executive power – legislative power – judicial power • structure of government – federal – unitary • laws, rules and regulations as they apply to: – political parties – voters – systems of representation – interest groups – media – dissemination of information – limits on dissent – role of the military, police, civil service
c. **political systems may be organized in a democratic manner**	democracy	Briefly identify the major types, characteristics and features of democratic systems: • types – direct/representative – parliamentary – presidential • characteristics/features – majority rule – citizenship participation – accountability of government to the people – minority rights – guarantee of individual rights and freedoms – opposition – limits on dissent – provision for changes to the system – political parties – electoral systems

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICAL AND ECONOMIC SYSTEMS IN THEORY (continued)		
d. **political systems may be organized in a dictatorial manner**	dictatorship	Briefly identify the major types, characteristics and features of dictatorship: • types – autocracy – oligarchy – majority tyranny – minority tyranny – absolute monarchy – military dictatorship • characteristics/features – authoritarian – totalitarian – use of force – control of media – controlled participation – limits on dissent – lack of accountability – provision for changes to the system – indoctrination – direction of popular discontent
e. **economic systems are organized to deal with the production and distribution of goods and services in society**	scarcity	Examine the basic economic questions that must be answered in any economic system: • what to produce? – limits – choices/opportunity costs • how to produce? – land/labour/capital • how to distribute? – allocation of goods/services • who makes the decisions about the allocation of resources, methods of production and the distribution of goods and services?

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICAL AND ECONOMIC SYSTEMS IN THEORY (continued)		
f. **economic systems may be based on the principles of private enterprise**	private enterprise capitalism market economy	Identify the major characteristics of a private enterprise system: • private property • competition • individual incentive • invisible hand • supply and demand • how the basic economic questions are answered
g. **economic systems may be based on principles of public enterprise**	public enterprise socialism centrally planned economy	Identify the major characteristics of a public enterprise system: • collective property • cooperation • group incentive • central planning • how the basic economic questions are answered
THEME II: POLITICAL AND ECONOMIC SYSTEMS IN PRACTICE		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **in practice, political and economic systems differ from theory**	mixed economy adaptation tradition	Use Canada, the United States of America, the Soviet Union, Nazi Germany and Sweden as examples to show how ideas and ideologies are used in practice Refer to other current examples to illustrate how systems differ from theory

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: POLITICAL AND ECONOMIC SYSTEMS IN PRACTICE (continued)		
b. **political and economic systems adapt to new ideas and changing circumstances**	collectivization privatization nationalization intervention depression business cycle deregulation	Briefly examine political and economic changes in: • Canada – role of government – monetary policy – fiscal policy • the United States of America – Great Depression – New Deal – Keynesian economics/ demand-side economics – Reaganomics/supply-side economics • the Soviet Union – under the leadership of Lenin and Stalin – under the leadership of Gorbachev (glasnost and perestroika) • an economy in transition; e.g.: – Russia, China • Sweden – welfare state
c. **political leaders achieve, exercise and maintain power in different ways in democracies and dictatorships**	majority rule totalitarianism elitism accountability	Examine how political power was achieved, exercised and maintained in democracies and dictatorships: • Canada; e.g.: – responsible government • the United States of America; e.g.: – separation of powers • the Soviet Union; e.g.: – the Russian Revolution and the role of the Communist Party • Nazi Germany; e.g.: – the role of Hitler and the Nazi Party

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: POLITICAL AND ECONOMIC SYSTEMS IN PRACTICE (continued)		
d. **the role of the individual in society is affected by the emphasis placed on collective good or individualism**	individualism collectivism political rights economic rights minority rights democratic socialism neo-conservatism	Briefly consider the role of laws, rules and regulations, and basic rights, as well as responsibilities of the individual in: • Canada • the United States of America • the Soviet Union • Sweden • Nazi Germany
e. **new issues and ideas challenge traditional political and economic beliefs and practices**	human rights justice human survival globalization	Identify recent issues that illustrate the need for change and adaptation in existing political and economic arrangements. These may involve issues drawn from: • environmental concerns • changing economic conditions • changing ideological perspectives

Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic B or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **access and use appropriate sources of information**
- **synthesize information and ideas**
- **determine underlying assumptions of a statement or position**
- **formulate and evaluate alternative conclusions, solutions and decisions**
- **logically defend a position on an issue or a problem.**

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Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **develop a thesis and support it in a well-written essay**
- **express ideas and information by constructing graphs, charts, concept maps and timelines**
- **effectively defend a point of view, orally or in writing.**

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **work effectively with others in a group setting to reach consensus or compromise**
- **assume appropriate leadership and support roles**
- **use a variety of skills in an appropriate manner—exhibit confidence in own ideas and work, but present them in a considerate manner.**

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions using process, communication and participation skills.

Students will be expected to develop the ability to:

- **design, select and use appropriate inquiry strategies to answer questions, solve problems and make decisions**
- **demonstrate maturity of thought in stating and defending a position**
- **use creative analogy and metaphor to show relationships or to describe a situation.**

Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation of independent and critical thinking about significant social issues**
- **intellectual curiosity, open-mindedness and interest in current issues related to political and economic systems**
- **an appreciation of the strengths and weaknesses of different economic and political systems**
- **and demonstrate a commitment to citizenship in democratic systems.**

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THE CONTEMPORARY WORLD
Topic B: Global Interactions

DESCRIPTION

Nations have used a variety of means to protect, sustain and enhance their national interests. Interaction among nations has increased global interdependence. World peace and security depend on limiting confrontations and increasing cooperation and understanding. Individuals, groups and nations must make informed decisions on issues regarding their interests and global survival. In order to gain an understanding of the contemporary world, students will focus on the motives, consequences and alternative choices in twentieth century global interactions since World War I.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- evaluate the desirability and effectiveness of the strategies and techniques used by individuals and governments to further their national interests
- analyze international events to determine their impact on people and on global cooperation and understanding
- evaluate and assess a variety of viewpoints on international issues before forming an opinion
- propose solutions to international problems, and assess the viability of the alternatives.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- Should individuals, groups and nations pursue international stability at the expense of national interests?
- Should international organizations be used to achieve global collective security?
- Should nations form alignments to protect their own interests, or to further international understanding?
- Should nations pursue national interests beyond their boundaries?

Examples of Questions

- What motivates nations to take on particular roles in international affairs?
- What are the major causes of twentieth century confrontations?
- What agencies exist to encourage cooperation among states?
- What role can an individual or group play in international affairs?
- How has the power and influence of nations shifted in the course of the twentieth century?
- Does the nation-state still have a role in the global economy?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: INTERNATIONAL CONFRONTATION AND COOPERATION: AN INTRODUCTION		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **international confrontations arise from a variety of motives and result in different types of interactions**	confrontation	Briefly illustrate the following motives and forms of international confrontation: • motives – nationalism – self-determination – expansionism – ideology/beliefs • forms of confrontation – total war – limited war – guerrilla war – terrorism – brinkmanship – diplomatic – economic

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: INTERNATIONAL CONFRONTATION AND COOPERATION: AN INTRODUCTION (continued)		
b. **international cooperation arises from a variety of motives and results in different forms of cooperation**	cooperation	Briefly illustrate the following motives and forms of international cooperation: • motives – collective security – internationalism – nationalism – balance of power – economic prosperity – humanitarianism – global survival • forms of cooperation – alliances – economic blocs – political groupings – regional organizations – international organizations – agreements – non-governmental organizations; e.g., cultural groups, popular movements
THEME II: GLOBAL INTERACTIONS: INTERWAR PERIOD AND WORLD WAR II		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **international agreements may create the grounds for future confrontations**	nationalism national security self-determination	Review the situation at the end of World War I and the *Treaty of Versailles* to illustrate how the settlements contributed to future confrontations: • territorial adjustments • arms restrictions • reparations • limitations on sovereignty • war guilt clause

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: GLOBAL INTERACTIONS: INTERWAR PERIOD AND WORLD WAR II (continued)		
b. **attempts at international cooperation are sometimes successful**	internationalism	Identify various forms of international cooperation in the interwar period: • League of Nations • Treaties/agreements: Dawes Plan, Kellogg-Briand Pact, Locarno • conferences
c. **security arrangements may strengthen or undermine global systems of collective security**	regional security global collective security alliances appeasement	Examine the search for security in the 1920s and 1930s by referring to: • global collective security: – League of Nations • regional security arrangements: – Little Entente • isolationism: – United States of America • treaties: – Munich Agreement – Nazi–Soviet Non-aggression Pact
d. **expansionist foreign policy may arise from a variety of motives or circumstances and elicit a variety of responses**	economic security ideologies expansionism	Examine the policies and motives of nations who promoted or opposed expansionism in the 1930s by referring briefly to the circumstances faced by: • Germany • Italy • Japan • the Soviet Union • France • Great Britain • the United States of America
e. **World War II altered both the nature of warfare and the international balance of power**	conflict total war genocide balance of power justice human rights	Briefly examine the impact of World War II: • brief overview of the war – the expansion of the Axis Powers – the Grand Alliance – the defeat of the Axis Powers and unconditional surrender

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: GLOBAL INTERACTIONS: INTERWAR PERIOD AND WORLD WAR II (continued)		• the changing nature of warfare – blitzkrieg – the Holocaust – civilian bombing – Hiroshima/Nagasaki • concern about justice and human rights – *Atlantic Charter* – war crimes • war time conferences – Yalta – Potsdam
THEME III: THE RISE AND INTERACTION OF THE SUPERPOWERS (1945–1991)		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **a shift in the balance of power results in new alignments among nations**	balance of power spheres of influence containment cold war	Briefly describe the emergence of the cold war in Europe and Asia: • the Iron Curtain • Marshall Plan • Truman Doctrine • Berlin Blockade • NATO • COMECON • Warsaw Pact • Korean War • SEATO
b. **the emergence of new nation–states influenced the foreign policies of the superpowers**	decolonization guerrilla warfare limited war	Briefly examine how issues raised by the emergence of new nations influenced the foreign policy of the superpowers: • Israel and the Middle East • China (1949) • Vietnam

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: THE RISE AND INTERACTION OF THE SUPERPOWERS (1945–1991) (continued)		
c. **international arrangements for global peace and stability take into account the realities of power**	global collective security	Describe the structure, procedures and role of the United Nations in maintaining international peace: • General Assembly • Security Council • peacekeeping forces
d. **the superpowers have faced pressures of self-determination within their spheres of influence**	terrorism non-alignment civil war self-determination	Briefly examine the challenges faced by the Soviet Union in Eastern Europe and Afghanistan, and the United States of America in Cuba, Nicaragua and the Middle East
e. **the development of nuclear weapons has been viewed as both a stabilizing and a destabilizing influence in international relations**	brinkmanship deterrence detente peaceful coexistence arms race disarmament	Identify the following as examples of stabilizing or destabilizing developments: • nuclear arms control treaties: – Strategic Arms Limitations Talks (SALT) – Strategic Arms Reduction Treaty (START) • nuclear arms confrontation: – Cuban Missile Crisis • nuclear arms technology: – cruise missiles – Strategic Defence Initiative (SDI) • international conferences; e.g.: – summit conferences – European security conferences

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME IV: CONTEMPORARY GLOBAL INTERACTIONS		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **global interactions are increasingly influenced by economic developments**	interdependence	Briefly examine the impact on the international community of the following: • growth of multinational corporations • shifts in industrial production; e.g., Pacific Rim nations • international debt • globalization; e.g., WTO, IMF, G7/G8 Nations, World Bank, free trade agreements
b. **nations form regional organizations to solve common problems**	regional cooperation	Describe the purpose for regional cooperation by examining the European Union and one other organization; e.g., North American Free Trade Agreement (NAFTA)
c. **concern for global peace, human rights and the environment has emphasized the need for international cooperation and understanding**	humanitarianism environmentalism	Identify the role of the following in international cooperation and understanding: • *Universal Declaration of Human Rights* • UN initiatives and agencies • Helsinki Agreements • Amnesty International • non-nuclear arms control
d. **concern for global peace and stability has been heightened by the emergence of new states and the disintegration of others**	self-determination national sovereignty supranationalism	Briefly examine the emergence and disintegration of states, as a challenge to world peace and security, resulting from: • 1989 revolutions in Eastern Europe • the re-unification of Germany • the disintegration of states; e.g., Soviet Union, Yugoslavia

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME IV: CONTEMPORARY GLOBAL INTERACTIONS (continued)		Briefly examine the following as examples of challenges to world peace and security and responses to them: • Gulf War • nuclear proliferation • ethnic conflict/civil wars/tribal conflict • peacekeeping • peace making • changing roles of alliances

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic A or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **prepare, interpret and analyze retrieval charts, concept maps, timelines, graphs and maps**
- **critically evaluate the message in visual material, and identify the purpose and intended audience**
- **analyze information from a variety of sources, compare different points of view and predict outcomes**
- **propose and evaluate solutions to international problems.**

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **express ideas clearly in oral form for a variety of purposes and audiences**
- **write persuasively and effectively to support one's point of view**
- **construct and use visual aids to support ideas.**

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **display self-confidence and respect for the opinion of others when discussing social issues**
- **work effectively with others in a variety of group settings**
- **participate effectively in social and political processes.**

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions using process, communication and participation skills.

Students will be expected to develop the ability to:

- **explain the cause and effect relationships among historical events**
- **establish relationships between historical events and present circumstances**
- **evaluate strategies used by nations, organizations and individuals in dealing with international problems**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues regarding international interactions.**

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **a sense of curiosity regarding patterns of global interaction**
- **an appreciation of the interdependent nature of the world**
- **an active interest in international issues and events**
- **commitment to the achievement of constructive and positive global interactions**.

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SOCIAL STUDIES 13–23–33

A. PROGRAM RATIONALE AND PHILOSOPHY

Social studies is a school subject that assists students to acquire basic knowledge, skills and positive attitudes needed to be responsible citizens and contributing members of society. The content of social studies draws upon history, geography, economics, other social sciences, and the humanities. The content serves as the context in which important skills and attitudes are developed.

Central to all curricula are the students. The Alberta Social Studies Program takes the following factors into account:

The Nature and Needs of the Learner: The expected learnings are consistent with the social and intellectual maturity of the students.

The Nature and Needs of a Changing Society: The program prepares students for active and responsible participation in a changing world. It seeks to equip students with the knowledge and skills necessary to function in the society in which they must ultimately find their place.

The Nature of Knowledge in Each Subject Area: The program content reflects the vast scope of the disciplines of history, geography, economics and social sciences at a level consistent with the maturity of the students.

The Learning Environment: The program identifies what is to be taught and provides the flexibility for teachers to adapt the program to meet the needs of the learners. It addresses the needs and conditions in schools and the availability, accessibility and variety of learning resources within the school and community.

In our changing society, students will need to be practised at using a variety of skills and strategies. Students will need to be able to acquire knowledge, to interpret and communicate information, and to solve problems and make decisions. In doing all of this, students require a wide range of critical and creative thinking skills and strategies that they can apply to a variety of situations. Therefore, the concept of learners as receivers of information should be replaced with a view of learners as self-motivated, self-directed problem solvers and decision makers who are developing the skills necessary for learning and who develop a sense of self-worth and confidence in their ability to participate in a changing society.

In order to accommodate students with a wide range of abilities, needs, interests and aspirations, two sequences for the Senior High School Social Studies Program have been developed. Although the content, skills and attitudes are similar for both sequences, the expectations for Social Studies 10–20–30 are more challenging, particularly in the

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depth of concept development, the level of critical and creative thinking, and inquiry skill development. The nature of the student learning resources that are approved for each sequence differ.

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B. GENERAL LEARNER EXPECTATIONS

RESPONSIBLE CITIZENSHIP

Responsible citizenship is the ultimate goal of social studies. Basic to this goal is the development of critical thinking. The "responsible citizen" is one who is knowledgeable, purposeful and makes responsible choices. Responsible citizenship includes:

- understanding the role, rights and responsibilities of a citizen in a democratic society and a citizen in the global community
- participating constructively in the democratic process by making rational decisions
- respecting the dignity and worth of self and others.

Citizenship education is based on an understanding of history, geography, economics, other social sciences and the humanities as they affect the Canadian community and the world. However, knowledge is changing rapidly. These changes bring into focus the need to provide the knowledge and skills necessary to meet the challenges of, and keep pace with, an ever-changing world. Therefore, emphasis is placed on learning those social studies facts, concepts, generalizations and skills that are useful for lifelong learning and responsible citizenship.

Social studies is organized around knowledge, skill and attitude objectives. These objectives should not be addressed separately or sequentially. The achievement of any one objective is directly related to the achievement of another; hence, they should be pursued simultaneously. The responsible citizen uses the knowledge, skills and attitudes acquired from the school, the family and the community.

In order to understand why people act the way they do, one has to examine the underlying reasons for their actions, including their values. Development of understanding of values (identification, definitions, descriptions) is incorporated in the knowledge objectives, and development of competencies (value analysis, decision making) is incorporated in the skill objectives.

KNOWLEDGE OBJECTIVES

To be a responsible citizen, one needs to be well-informed about the past as well as the present, and to be prepared for the future by drawing from history and the social sciences disciplines. The knowledge objectives take into account the history of our community, the nature of a democratic society, an understanding of the nature of man, and an understanding of our changing social, political, technological and economic environments.

Knowledge objectives for social studies topics are organized through generalizations and key understandings, concepts and related facts.

- Generalizations are rules or principles that show relationships among two or more concepts.
- Key understandings are statements of major understandings related to the content of the unit.
- Concepts are ideas or meanings represented by words, terms or other symbols that stand for a class or group of things.
- Facts are parts of information that apply to specific situations; for example, specific statements about people, places, events or ideas.

SKILL OBJECTIVES

Skills are taught best in the context of use rather than in isolation. While skill objectives are grouped into categories for organizational purposes, some of the skills may fit into more than one category. There is a wide variety of thinking skills essential to social studies. These skills are not intended to be developed separately or sequentially and are intertwined with the knowledge and attitude components. Skill objectives for social studies are grouped into the following categories:

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Process Skills	–	skills that help one acquire, evaluate and use information and ideas
Communication Skills	–	skills that help one express and present information and ideas
Participation Skills	–	skills that help one interact with others

Inquiry Strategies

Inquiry strategies help one answer questions, solve problems and make decisions, using process, communication and participation skills. Thinking skills are developed by providing students with many experiences, using strategies, such as problem solving and decision making. The intent is to provide many opportunities within a topic/grade to use problem solving and/or decision making so that the students learn the strategies and then are able to transfer the skills to their own lives. Each topic includes questions that range from those that have an answer based on the available evidence, to those that are issues that need to be resolved. A problem may be defined as any situation for which a solution is desired. An issue may be defined as a matter of interest about which there is significant disagreement. The disagreement can involve matters of fact, meaning or values.

Each topic includes a section Issues and Questions for Inquiry. These sections are not intended to be exclusive. The success of inquiry is enhanced by selecting questions and issues related to the topic that are concrete, relevant, meaningful and of interest to students. Issues and questions can be teacher- or student-generated.

Issues and questions may be investigated, using different strategies. Critical thinking and creative thinking may be encouraged by using a variety of inquiry strategies, such as the problem-solving, decision-making and inquiry process models outlined below. Inquiry calls for choosing and blending strategies. Sometimes, a step-by-step approach may be best. At other times, a more flexible approach may be used. The following strategies can be expanded, modified or combined to suit specific topics, disciplinary emphases, resources and student maturity. Problem solving is a strategy of using a variety of skills to answer a question or solve a problem (who, why, what, where, when, how). Decision making is a strategy that uses values and a variety of skills to determine a solution to a problem/issue that involves a choice (should, how should, to what extent should) and that requires a decision for action. Large issues requiring a policy decision may be addressed through an inquiry strategy. The strategies provided in curriculum documents vary from elementary through secondary levels.

A Model for Answering Questions or Solving Problems

- Define a question/problem
- Develop questions or hypotheses to guide research
- Gather, organize and interpret information
- Develop a conclusion/ solution

A Model for Making Decisions

- Identify an issue
- Identify possible alternatives
- Devise a plan for research
- Gather, organize and interpret information
- Evaluate the alternatives, using collected information
- Make a decision; plan or take action consistent with the decision, if desirable and feasible
- Evaluate the action plan and decision-making process

A Model for the Inquiry Process

- Identify and focus on the issue
- Establish research questions and procedures
- Gather and organize data
- Analyze and evaluate data
- Synthesize data
- Resolve the issue
- Apply the decision, or postpone taking action
- Evaluate the decision, the process and, where pertinent, the action

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ATTITUDE OBJECTIVES

The attitude objectives describe a way of thinking, feeling or acting and are developed through a variety of learning experiences that encompass knowledge and skill objectives. These experiences include participation in specific activities, the development of positive attitudes toward one another, and learning in an atmosphere of free and open inquiry. Attitude objectives should receive continuous and informal evaluation.

The development of the positive attitudes needed for responsible citizenship is a gradual and ongoing process. The attitude objectives for social studies, which students should develop, include:

- positive attitudes about learning
- positive and realistic attitudes about one's self
- attitudes of respect, tolerance and understanding toward individuals, groups and cultures in one's community and in other communities: local, regional, national, global
- positive attitudes about democracy, including an appreciation of the rights, privileges and responsibilities of citizenship
- an attitude of responsibility toward the environment and community: local, regional, national, global.

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C. SPECIFIC LEARNER EXPECTATIONS

The **specific** learner expectations in Social Studies 13, 23 and 33 are organized into knowledge, skill and attitude objectives. These objectives will be integrated into appropriate classroom experiences (exercises and activities) for learners. The **required** component comprises 80% of the program and is represented by topics and statements of objectives that follow. The required component contains the knowledge, skills and attitudes that all students should be expected to acquire. The **elective** component should occupy 20% of the program. The elective component provides enrichment and remediation consistent with the content and objectives of the required component and provides opportunities to adapt or enhance instruction to meet the diverse needs and abilities of students.

The study of **current affairs** adds considerably to the relevance, interest and immediacy of the Alberta Social Studies Program. It is expected that current affairs will be handled as inclusions and extensions of curricular objectives, not as a separate topic isolated from the program. Examination of events or issues of significant local, national or international importance is encouraged, provided a balanced approach to goals of responsible citizenship is employed and the prescribed objectives of the course are met.

Evaluation, within the Alberta Social Studies Curriculum, is the process of collecting, processing, interpreting and judging program objectives, teaching strategies, student achievement and instructional resources. Evaluation is important during all phases of planning and learning. It should begin with an assessment of student needs, and include consideration of ways that basic resources and support materials can be used to improve learning. Ongoing evaluation determines how well students are achieving prescribed objectives and permits the planning of specific learning experiences. Evaluation should assess the degree of overall success in meeting learning expectations in the program including knowledge, skill and attitude objectives. Knowledge and skill objectives should have equal weight in the evaluation used to calculate grades. Assessment of attitude objectives should not be used in calculating grades.

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SOCIAL STUDIES 13

CANADA IN THE MODERN WORLD
Topic A: Challenges for Canada: The 20th Century and Today

DESCRIPTION

Canada has evolved into a sovereign nation with a unique identity. In order to understand the development of their country as a nation and its role in the world community, students will examine some of the forces that have shaped Canada and the factors that give Canadians their unique identity. The object of this study is to provide students with the knowledge and skills necessary to participate more effectively as citizens of Canada and the world.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- assess the strengths and weaknesses of Canada as a nation
- assess the effect of regionalism on Canada
- understand why Canada has developed as a diverse community
- develop and analyze possible solutions to current challenges for Canada as a nation.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. In choosing the issue and the question, one must fall under the national focus and one under the international focus. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- To what extent should Canadians encourage the development of a national identity?
- Should Canada provide for security by maintaining membership in regional alliances?
- How should Canada respond to current challenges/issues related to sovereignty?
- Should Canadians become more involved with global issues?

Examples of Questions

- How have Canadians developed a sense of unity as a nation in spite of diversity?
- Do regional differences contribute to or detract from the development of Canada?
- What has Canada done to become a sovereign and secure nation while promoting cooperation with other nations?
- How has Canada cooperated with other nations and international organizations?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: DIVERSITY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **Canada is a pluralistic community with different political, social, cultural and economic dimensions**	pluralism diversity	Identify a variety of political, religious, economic, ethnic and cultural groups in Canada
	regionalism	Examine geographic regions with reference to: • economic diversity • resource distribution • population distribution
	disparity	Identify socioeconomic indicators to illustrate disparity: • per capita income • unemployment rate • training/educational levels • cost of living • standard of living

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: DIVERSITY (continued)		
	alienation	Select at least one example of a group or political party to illustrate alienation; e.g.: • Cooperative Commonwealth Federation • Union Nationale • Social Credit • Reform Party • Parti Québécois • Bloc Québécois
THEME II: UNITY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **there are political, social, cultural and economic factors that foster a sense of Canadian community**	community	Select one example of a national institution that has been used to foster a sense of community; e.g.: • CBC • CPR • Trans-Canada Highway Examine bilingualism and multiculturalism as they relate to Canadian unity: • bilingual policies • multicultural policies
	interdependence compromise equalization	Select at least one example of a government policy or program that is intended to reduce economic disparity; e.g.: • equalization payments • transfer payments • western diversification • medicare

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: IDENTITY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **the Canadian identity is shaped by a variety of factors arising from our history and geography**	cultural diversity	Examine the following factors as they relate to the Canadian identity: • national symbols • values/beliefs • our own and others' perceptions of Canada • Cultural Diversity – Aboriginal peoples (Inuit, First Nations, Métis) – two founding nations – other cultural groups • population distribution according to cultural background
b. **an individual's cultural identity is influenced by interaction with others**	cultural identity	Examine how one's identity is influenced by: • family, church, community • majority/minority status • change in one's cultural identity occurs in part as a result of interaction with people

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Subtopic: Canada in the World

This subtopic has three themes: *Sovereignty*, *Security* and *Cooperation*.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: SOVEREIGNTY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **Canada has evolved as a nation**	independence sovereignty	Examine the significance of the following in Canada's evolution toward a sovereign nation: • Confederation (1867) • control of foreign policy decisions – declaration of war/ World War I – *Statute of Westminster*, 1931 – declaration of war/ World War II • the *Constitution Act*, 1982 Select one example to explain economic/cultural sovereignty; e.g.: • foreign investment • free trade; e.g., North American Free Trade Agreement (NAFTA) • fishing limits • law of the sea • acid rain • Great Lakes pollution • Arctic sovereignty • media

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: SECURITY		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **Canadian security has been achieved and is maintained through alliances, agreements and independent action**	alliances	Briefly examine historical and current military involvements: • Canada in the British Empire • NATO • NORAD • entering World War II
THEME III: COOPERATION		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **Canada works cooperatively and collectively with other nations and within world agencies and organizations**	internationalism	Select examples of Canada's international involvements; e.g.: • United Nations – peacekeeping • foreign aid programs • Commonwealth • La Francophonie • sports

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic B or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **select appropriate sources of information on an issue**
- **organize and use information from a variety of sources, including print and nonprint**
- **identify bias in various sources**
- **compare a variety of viewpoints on issues**
- **take effective notes and summarize materials.**

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **express and defend ideas in written form**
- **express ideas in visual form, by preparing materials for display**
- **discuss and defend a point of view**
- **report on research results.**

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **work at individual tasks in a group situation**
- **work together in proposing and discussing alternative solutions to issues**
- **cooperate in decision making.**

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions, using process, communication and participation skills.

Students will be expected to develop the ability to:

- **apply critical and creative thinking skills in problem solving and decision making**
- **examine and consider alternatives before making a decision**
- **assess the consequences of taking a particular course of action**
- **evaluate the effect of a particular decision taken by the Government of Canada**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues.**

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **respect for and appreciation of the uniqueness of Canada**
- **an appreciation of our evolving Canadian heritage**
- **openness to new ideas and opinions about the nature of Canadian society**
- **respect for the right of all Canadian citizens to express alternative points of view**
- **sensitivity to what being Canadian means to different people in different regions of Canada**
- **preference for peaceful resolution of conflict in personal relations and in society as a whole**
- **respect for the many cultural groups in Canada**
- **continuing interest in national, political, social and cultural affairs in Canada**
- **an appreciation of Canada's role as a nation in an interdependent world**.

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CANADA IN THE MODERN WORLD
Topic B: Citizenship in Canada

DESCRIPTION

Responsible citizenship in a democratic society such as Canada's requires the understanding and the exercising of rights and responsibilities by individuals and groups. In this unit, students will gain an understanding of the rights and responsibilities of citizenship and the knowledge and skills necessary for participation in the Canadian political process and in Canadian society.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- **assess the strengths and weaknesses of Canada's democratic system**
- **evaluate the adequacy of human rights protection in Canada**
- **assess a variety of points of view on controversial citizenship issues before forming an opinion**
- **develop and examine possible solutions to current citizenship issues**.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one question and one issue must be addressed using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- To what extent should individual freedom be limited in order to benefit society?
- To what extent should citizens participate in their community?
- Should voting in elections be required by law?
- Should elected representatives vote according to the views of their constituents or according to the position taken by their party?

Examples of Questions

- What are the rights and responsibilities of a citizen in a democratic society?
- How is the balance between social control and the protection of individual freedom provided for in the Canadian system of government?
- How do individuals and groups influence the political decision-making process?
- Why is it necessary to have an informed public in a democratic society?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: RIGHTS AND RESPONSIBILITIES		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **there are rights and responsibilities associated with citizenship**	rights responsibilities	Briefly explain rights and responsibilities of citizens: • rights – *Canadian Charter of Rights and Freedoms*, 1982 – *Alberta Human Rights, Citizenship and Multicultural Act*, 1996 – Alberta Human Rights Commission – legal rights • responsibilities – legal; e.g., jury duty – implied; e.g., caring for others

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: RIGHTS AND RESPONSIBILITIES (continued)		
b. **the rights and responsibilities of individuals and groups in Canadian society have evolved and continue to change**	discrimination prejudice respect	Study at least one example of a situation where individual freedom or rights have been limited; e.g.: • Aboriginal peoples' rights • children's rights • the rights of persons with disabilities • language rights • minority rights • gender rights • workers' rights
THEME II: GOVERNMENT AND POLITICS		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **politics are a feature of everyday life**	decision making	Illustrate consensus, influence, negotiation and compromise by referring to examples from: • school • community • workplace • provincial level • national level
b. **in order to function, Canada's government has a formal structure based on underlying rules and principles**	federalism democracy rule of law party system responsible government	Describe Canada's political structure by explaining the following: • constitutional monarchy • representative government • constitution • levels of government – federal – provincial – municipal • branches of government – executive – legislative – judicial

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: GOVERNMENT AND POLITICS (continued)		• passage of a bill • major political parties – Liberal – Progressive Conservative – New Democratic Party – Bloc Québécois – Canadian Alliance
c. **in a democratic society there are a variety of means used to resolve disagreements peacefully**	conflict cooperation justice	Choose at least one example of a resolution of either an historical or a current disagreement; e.g.: • use of court appeals • plebiscite/referendum • political compromise • negotiation • arbitration
THEME III: CITIZEN PARTICIPATION		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **citizens can be involved and participate in society**	participatory citizenship	Select examples of community involvement; e.g.: • Rural/Neighbourhood Crime Watch • Block Parent • Crime Stoppers • service groups • volunteers
b. **there are methods of participating in and influencing the political decision-making process in Canada**	power influence	Examine how individuals participate in the political process; e.g.: • campaigning/joining/forming parties • voting • joining or influencing those who have power and influence • example of media influence on political decision making • labour and professional groups

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: CITIZEN PARTICIPATION (continued)		Examine examples of input by citizens; e.g.: • letters • petitions • plebiscite/referendum • demonstrations • lobbying by special interest groups
c. **Canadian citizenship is acquired by various methods**	citizenship	Identify methods of gaining citizenship: • naturalization • birth

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic A or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **identify and use relevant information from print and nonprint sources**
- **distinguish between fact and opinion**
- **analyze a variety of proposed solutions to a problem or an issue**
- **organize material in note form**.

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **defend a position in a short, written assignment**
- **discuss issues**
- **convey information and express ideas, using a visual format**
- **speak effectively in presenting a point of view**.

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **interact with others in a variety of group settings**
- **participate in group decision making**
- **work effectively with others**.

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions, using process, communication and participation skills.

Students will be expected to develop the ability to:

- **use the creative and critical thinking skills necessary for responsible citizenship**
- **consider alternatives, make decisions and substantiate choices**
- **examine the processes whereby decisions affecting themselves and society are made**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues**.

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation of the responsibilities inherent in the democratic way of life**
- **a willingness to accept responsibility for the consequences of one's actions**
- **an appreciation of and respect for the rights of others**
- **and value peaceful resolution of conflict**
- **a respect for the rights of others to hold opinions different from one's own**
- **an appreciation of the fact that citizenship involves participation in the community and the nation**.

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SOCIAL STUDIES 23

THE GROWTH OF THE GLOBAL PERSPECTIVE
Topic A: The Development of the Modern World

DESCRIPTION

Important changes in European society have helped to shape the modern world. In this unit, students will examine three historical themes in European society: the shift from a local outlook to a more national outlook; the shift from a rural/agrarian way of life to an urban/industrial way of life; and the shift from a hierarchical society to a more egalitarian society. The object of this study is to provide students with an understanding of the impact new ideas and changes have had and continue to have on society.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- analyze the impact on the world of the growth of nationalism in Europe
- assess the impact of industrialization on Europe
- analyze the growth of egalitarianism in Europe
- draw comparisons between changes in Europe and developments in the world today
- evaluate the impact of nationalism on the world of the future.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- To what extent should nationalism be encouraged?
- Should further industrialization be encouraged?
- Should society provide for greater social equality?

Examples of Questions

- How did nationalism develop in Europe?
- What were some positive and negative consequences of the development of nationalism?
- Why can industrialization be viewed as a positive or a negative force?
- How have demands for social equality had an impact on Europe?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: NATIONALISM		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **people lived more localized lives in the past**	tradition loyalty	Select an example to illustrate locally focused life: • pre-revolutionary France
b. **a sense of national identity came to play a more important role in people's lives**	patriotism nation nationalism	Examine the French Revolution to show evolving nationalism: • causes • new sense of nationalism; e.g.: – National Assembly – symbols (flag/anthem/ holidays) – levée en masse – public education • Napoleon's use of nationalism

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: NATIONALISM (continued)		
c. **the rise of nationalism has resulted in conflicting national interests**	alliances militarism conflict total war	Examine nationalism in the nineteenth and early twentieth centuries: • national unification – Germany • World War I – causes, including national, economic and military rivalries – the nature of the conflict; e.g., trench warfare, new weapons – Treaty of Versailles
d. **nationalism continues to be an important force in the twentieth century**	sovereignty self-determination	Select an example to illustrate types of nationalism in today's world; e.g.: • a group seeking to be recognized as a nation • a nation striving to maintain its independence • a nation acting in its own interest within the international sphere; e.g., economically, militarily, or in sports
THEME II: INDUSTRIALIZATION		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **European society was agrarian and localized in the past**	social hierarchy	Select an example to illustrate the nature of pre-industrial society: • England • France

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: INDUSTRIALIZATION (continued)		
b. **industrialization contributed to numerous and extensive changes in European society**	industrialization urbanization	Examine the impact of industrialization in England or France: • causes • economic development – expansion of markets – growth of factories • society – urbanization – quality of life – rise of the middle class – rise of the working class • politics – a brief reference to liberalism, conservatism, socialism
c. **industrialization affected Europe's relations with the rest of the world**	imperialism	Examine the relations between industrialized European nations and other nations: • nineteenth century imperialism – causes – examples – effects on international relations
d. **industrialization continues to be a major force**	technology	Select at least one example of the impact of industrialization on today's world; e.g.: • effects of new technology; e.g., computers, automation • newly industrialized nations; e.g., South Korea, Mexico

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: EGALITARIANISM		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **people lived in a more stratified and highly immobile society in the past**	privilege	Examine the structure of society in pre-revolutionary France: • Three Estates
b. **equality and the potential for social mobility have increased for the individual**	equality mobility individual freedoms	Select examples from revolutionary France or nineteenth century England to illustrate: • social mobility • distribution of wealth • extension of suffrage
c. **changes in equality and social mobility have had, and continue to have, an impact on society**	egalitarianism	Examine the impact on society (past and present) of several of the following changes: • social programs • education • universal suffrage • role of women • protection of rights

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic B or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **interpret written and visual materials**
- **summarize written materials**
- **analyze data through concept mapping or retrieval charts**
- **use maps to gather, analyze and provide information**
- **assess more than one point of view on an issue**.

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **construct time lines, flow charts and retrieval charts to display ideas**
- **defend a point of view in a multi-paragraph composition**
- **prepare a research project with a bibliography**
- **present an informed position in a discussion or informal debate**.

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **contribute to group discussions**
- **work effectively with others in a variety of group settings**
- **work within group rules and decisions to complete a task**
- **organize and plan activities, and help make decisions as a group member**.

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions, using process, communication and participation skills.

Students will be expected to develop the ability to:

- **evaluate the effect of a particular change on European society in the past**
- **examine the impact of one force of change from Europe on the modern world**
- **examine a variety of viewpoints before forming an opinion**.

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation that present society has been shaped by past experiences**
- **an appreciation that change in society is accompanied by positive and negative consequences**
- **an appreciation that alternative viewpoints exist toward developments that have changed our society**
- **an appreciation of the role of new ideas and developments in a changing society**
- **respect for the right of others to hold a different point of view**.

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THE GROWTH OF THE GLOBAL PERSPECTIVE
Topic B: Challenges in the Global Environment

DESCRIPTION

Differing viewpoints on quality of life exist in today's world. In this topic, students will examine how global imbalances, environmental factors and differing perspectives influence quality of life in an interdependent global community. To improve quality of life, one must consider possible alternatives, as well as the impact of these changes. The object of this study is for students to recognize the diversity and interrelatedness of the world so that they can participate more effectively as responsible world citizens.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- evaluate the diversity and disparity of world regions
- explain the interdependent nature of the world
- examine quality of life from their own perspective and from other perspectives
- evaluate the impact of different approaches to development
- assess proposed future alternatives to current quality of life.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities, such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- To what extent should our concept of quality of life be used as a measure of quality of life in other nations?
- To what extent should the resources of the world be shared?
- Should we, as individuals, share the responsibility for meeting the social and economic needs of other people?

Examples of Questions

- What are some perspectives on quality of life?
- How do political and economic decisions and actions taken in one part of the world have effects on another part of the world?
- How does the use of resources affect the environment?
- How does the use of resources affect global relations?
- How can individuals or groups play a role in international issues?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: GLOBAL REGIONALISM		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **there is diversity in the economic and social conditions and cultural backgrounds of people in the world**	diversity disparity culture	Illustrate diversity in the world through a brief overview of world geography: • political units and alignments • geographical regions • economic zones Focus on examples of diversity in the world through a brief overview: • social conditions; e.g., health, literacy, nutrition, population growth • economic development; e.g., agriculture, manufacturing • cultural backgrounds; e.g., language, religion • political stability

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: GLOBAL REGIONALISM (continued)		
b. **perspectives on quality of life are influenced by various factors within a society**	quality of life standard of living value system	Illustrate differing perspectives and factors that influence quality of life by comparing selected countries from Africa, Asia and the Americas: • beliefs and values; e.g., religious, social and material • social structure • demography • environment • government policies • economic strategies
THEME II: GLOBAL INTERDEPENDENCE AND QUALITY OF LIFE		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **quality of life is influenced by the interdependence of peoples and nations**	interdependence	Select examples to illustrate global interdependence and its effect on quality of life; e.g.: • trade • multinational/transnational corporations • migration of people • technological exchange • cultural exchange/tourism • communication/transportation • diplomacy; e.g., economic summits • medical advances • foreign debt

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: GLOBAL INTERDEPENDENCE AND QUALITY OF LIFE (continued)		
b. **environmental situations affect quality of life**	environmental deterioration ecological balance resource depletion resource renewal	Select examples of environmental situations focusing on their effects on quality of life; e.g.: • deforestation/reforestation • desertification/reclamation • environmental pollution/ restoration; e.g., recycling, ozone layer depletion, greenhouse effect • ecological management; e.g., new crops, irrigation, conservation farming
c. **economic activities affect quality of life**	resource distribution cooperation technology	Select examples of economic activities that affect quality of life; e.g.: • foreign investment • trade • resource development • multinational corporations • industrial integration • local economic activities – subsistence agriculture – cooperatives – industries – other activities
d. **differing perspectives and approaches may be used to improve quality of life**	sustainable development social action	Choose examples of possible strategies that individuals or groups may take to improve quality of life; e.g.: • changes in government • redistribution of land • foreign aid • foreign investment • nationalization of key institutions/industries • education/training • use of technology • self-help projects and local initiatives • consumer awareness • volunteerism • political action

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic A or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **locate, interpret and organize information from print and nonprint sources**
- **identify points of view or perspectives from various sources of information**
- **predict outcomes of alternative futures based on factual data**
- **examine evidence and evaluate alternatives before making a decision**.

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **write a report based on factual data to support a position**
- **present information in such forms as maps, diagrams and charts**
- **prepare visuals and notes for delivery of a presentation**
- **defend a position in a group discussion**.

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **contribute information on issues and questions in the classroom**
- **work independently as part of a larger group**
- **work effectively with others in a variety of group settings**.

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions, using process, communication and participation skills.

Students will be expected to develop the ability to:

- **consider alternative perspectives, make decisions and defend their choices**
- **use appropriate inquiry models to answer questions, solve problems and resolve issues**
- **critically examine developments that may affect quality of life**
- **evaluate alternative solutions on global issues**.

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation that diversity exists in the world**
- **an appreciation that there are different perspectives on quality of life**
- **an appreciation that responsible world citizenship includes recognizing the interdependent nature of the world**
- **a respect for the right of others to hold different viewpoints on global issues**
- **an appreciation that there are varied approaches to the resolution of global issues**
- **an interest in current international issues**.

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SOCIAL STUDIES 33

THE CONTEMPORARY WORLD
Topic A: Political and Economic Systems

DESCRIPTION

Important differences exist in the way societies make decisions and how they satisfy their needs and wants. These differences reflect the value placed on individual and collective goals within political and economic systems. Consequently, the degree of freedom and control varies among different political and economic systems. The objective of this study is to enable students to acquire an understanding of major political and economic ideas and systems so that they can participate as effective and responsible citizens.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- compare the basic characteristics of the major political and economic systems
- evaluate strengths and weaknesses of the major political and economic systems in practice
- identify various viewpoints on issues and recognize the values underlying differing positions
- propose solutions to political and economic problems.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry. Issues and questions should be selected so that both the political and economic components of the topic are addressed.

Examples of Issues

- Should individuals be held responsible for their own economic well-being?
- To what extent should governments control the lives of individuals?
- To what extent should governments pursue the common good?
- Should political participation be compulsory?

Examples of Questions

- What are the essential features of the major political and economic systems?
- In what ways does leadership in democracies compare with leadership in authoritarian states?
- How do individuals exert influence within the major political systems?
- What are the similarities and differences between public and private enterprise?
- How are the decisions about the production and distribution of goods and services determined in each economic system?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICAL SYSTEMS		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **all societies have a form of political organization for decision making**	organization order security decision making	Examine simple organizational models relevant to student experiences to show the decision-making process; e.g.: • home, school, work, clubs, teams
b. **political systems are organized for the exercise of power by individuals and/or groups based on their ideology**	power leadership democracy/ participation majority rule/ minority rights dictatorship/elitism ideology fascism communism	Briefly compare dictatorship and democracy in terms of: • simple models of power and decision making – leadership (responsibility, division of power) – citizen's role • ideology – view of human nature – goals of systems

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: POLITICAL SYSTEMS (continued)		Use the criteria above to illustrate differences among the major political systems in practice; briefly examine examples of: • democracies – Canada – the United States of America • dictatorships – Nazi Germany – the Soviet Union • current and/or historical situations
c. **the role of the individual varies from one political system to another**	human rights citizenship	Compare political systems in terms of: • individual participation • decision making • basic human rights and freedoms
d. **political systems continue to evolve**	constitutional change reform	Examine examples of: • political change: – Canada (attempts at changing the Constitution) – Soviet Union (glasnost)
THEME II: ECONOMIC SYSTEMS		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **economic decisions must be made to meet the needs and wants of individuals because resources are limited**	scarcity needs wants cooperation competition	Use examples from student experiences to develop ideas about how we make choices within the limits of our resources; e.g.: • home, school, community, work
b. **economic systems are organized in different ways to deal with basic economic questions that arise from the problem of scarcity**	private enterprise public enterprise mixed economy individualism collectivism	Briefly examine the basic economic questions and how they are addressed in economic systems: • what is produced • how it is produced • how it is distributed/allocated

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: ECONOMIC SYSTEMS (continued)		Identify the essential features of the following types of economic systems: • market economy (capitalism) – supply and demand – individualism – incentive – private ownership • centrally planned economy (socialism) – central planning – collectivism – incentive – public ownership • mixed economy – balance between private and public enterprise – direct and indirect controls Briefly examine how economic decisions are/were made in the following countries: • Canada • the United States of America • the Soviet Union • Sweden
c. **each economic system provides benefits to individuals in varying degrees**	standard of living quality of life	Compare each economic system in terms of: • individual security • economic freedom • consumer choice • economic stability • economic growth • availability of basic services • efficiency • distribution of income • cost of living

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: ECONOMIC SYSTEMS (continued)		
d. **economic systems adapt to new ideas and changing circumstances**	government intervention privatization deregulation	Briefly examine several of the following ideas, and refer to current illustrations where appropriate: • incentives/subsidies • interest rate/money supply • redistribution of wealth • ownership and regulation of business • job creation • environmental legislation • other; e.g., Soviet Union (perestroika)

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic B or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **select and organize information from a variety of references for a particular purpose**
- **note key ideas to identify a speaker's or writer's purpose**
- **interpret information by selecting main ideas, key points and supporting points**
- **analyze information to detect bias, propaganda or opinion**
- **synthesize information to identify alternative positions**.

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **clearly express ideas in oral and written form**
- **express and defend a point of view**
- **select and use an appropriate medium for presenting ideas**
- **acquire and use vocabulary appropriate to course content**.

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **show respect for the rights and opinions of others**
- **work independently and in group settings**
- **share information on controversial issues in a rational manner**
- **identify and apply leadership abilities**.

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions using process, communication and participation skills.

Students will be expected to develop the ability to:

- **distinguish between relevant and irrelevant information**
- **use an appropriate problem-solving model to answer a question or solve a problem**
- **employ a decision-making model to examine alternatives for resolving an issue**
- **evaluate alternative political and economic systems in regard to individuals, groups and society**.

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **a willingness to accept some responsibility for political and economic matters affecting society**
- **a willingness to consider a variety of perspectives on an issue before making a decision**
- **an appreciation that decision making should be based on a critical examination of information and alternative viewpoints**
- **a positive attitude toward the exercising of responsibilities and rights of citizenship in a democratic society**.

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THE CONTEMPORARY WORLD
Topic B: Global Interaction: The 20th Century and Today

DESCRIPTION

Global interaction has been largely motivated by nations and groups seeking to promote and protect their own interests. In addition, international organizations and individuals have worked toward humanitarian goals. Concern about the consequences of conflict, a desire for peace, and an awareness of the interdependence of nations have led to increasing efforts and initiatives toward international cooperation. In order for students to participate effectively as responsible citizens of Canada and the world, they should understand how other nations and groups have sought to protect and promote their own national interests. Students should also appreciate how individuals and groups contribute to, and are affected by global interactions, and how these interactions have consequences for their lives and the global community.

CRITICAL AND CREATIVE THINKING GOALS

In order to encourage critical and creative thinking, students should acquire the knowledge and skills necessary to:

- develop criteria to assess efforts to promote international cooperation
- develop and evaluate approaches to resolving international disputes
- analyze the causes and consequences of selected major international disputes
- assess current international events from varying perspectives.

It must be recognized that the degree to which students will be able to address the goals listed above will vary. Students should engage in activities such as role playing, simulations, debates, presentations or research assignments that give them an opportunity to participate, and to develop critical and creative thinking. These goals can be used in conjunction with selected issues and questions for inquiry.

ISSUES AND QUESTIONS FOR INQUIRY

In this topic, at least one issue and one question must be addressed, using appropriate inquiry strategies (see page 4). Students are encouraged to address several issues and questions for inquiry. Teachers are encouraged to adapt these, and to develop other questions and issues for inquiry.

Examples of Issues

- Should nations ever go to war?
- To what extent should nations promote international cooperation and peace?
- Should individuals/organizations take a more active role in international affairs?
- To what extent should national needs and wants override global welfare?

Examples of Questions

- What major factors influence interaction among nations?
- How do nations seek to protect and enhance their own national interests?
- What are the major consequences of international disputes?
- In what ways can individuals contribute to resolving world problems?
- How have nations worked together to solve problems?
- How can the major threats to the survival of the global community be reduced?

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SPECIFIC LEARNER OBJECTIVES

In order to provide a clear statement of what students are expected to learn about this topic, the content has been organized into knowledge, skill and attitude objectives. However, for instructional purposes, the knowledge, skill and attitude objectives are to be incorporated into an organizational model for teaching the topic. Flexibility in selecting and designing an instructional organization for the unit is intended to accommodate the needs of students, maximize the use of available resources, and allow for coordination of instructional planning. Consequently, the knowledge, skill and attitude objectives should be integrated for instructional purposes, not taught in an isolated fashion. It is intended that each topic should receive equal emphasis in the course. Equal weighting should be given to knowledge and skill objectives in each topic. Attitude objectives should be addressed throughout the topic. Assessment of attitude objectives should not be used in calculating grades.

Knowledge Objectives

The generalizations and key understandings, concepts and related facts and content listed in this topic are presented as an outline of the required content and help to organize the knowledge objectives. **The generalizations and key understandings are the most important knowledge objectives**. The concepts and related facts and content should be developed and used to facilitate an understanding of the Generalizations and Key Understandings.

Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: INTERACTIONS AMONG NATIONS (1919–1945)		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **interactions among nations involve a wide range of motives, methods and consequences**	nationalism internationalism cooperation conflict	Examine simple models and/or examples from current events and student experiences to develop ideas about motives, methods and consequences of global interactions: • motives – security – peace – prosperity – promote or defend against ideologies – prestige

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: INTERACTIONS AMONG NATIONS (1919–1945) (continued)		• methods – treaties/agreements – diplomacy – sanctions – alliances – international law – confrontations – war • consequences – new social roles and attitudes – new economic and political relations – territorial changes
b. **major interactions among nations often result in changes within countries**	self-determination social change	Review changes that occurred as a result of World War I: • the effect of peace treaties in Europe – Treaty of Versailles • creation of new states – Poland – Czechoslovakia – Yugoslavia • social transformation – role of women – attitudes toward war
c. **global interaction results in new directions in international relationships**	global collective security national security	Examine the efforts of nations to provide for their security: • League of Nations • disarmament conferences • regional alliances • isolationism • appeasement
d. **economic crisis may result in changes that challenge international security**	depression militarism aggression arms race	Examine the challenges to international security prior to World War II posed by: • the Great Depression – protectionism – indebtedness • the rise of totalitarian states – Nazi Germany – Japan

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME I: INTERACTIONS AMONG NATIONS (1919–1945) (continued)		• the failure of the League of Nations – Japanese invasion of Manchuria – Italian invasion of Abyssinia – Germany's rearmament and expansion
e. **the Second World War changed the scope and nature of warfare**	total war genocide human rights	Examine the characteristics and consequences of World War II: • blitzkrieg • mass bombings • Holocaust • use of atomic weapons • war crimes
THEME II: THE RISE OF THE SUPERPOWERS AND THE EMERGENCE OF THE UNITED NATIONS (1946–1975)		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **since World War II, nations and international organizations have used a variety of means to provide for national interests and international stability in the world**	superpowers collective security regional alliances international organizations	Briefly examine how the following relate to international cooperation, international confrontation and superpower management of conflict: – wartime conferences – United Nations – Marshall Plan – COMECON – European Union

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME II: THE RISE OF THE SUPERPOWERS AND THE EMERGENCE OF THE UNITED NATIONS (1946–1975) (continued)		
b. **the struggle between the Soviet Union and the United States of America dominated international relations**	cold war brinkmanship spheres of influence confrontation containment deterrence peaceful coexistence	Refer to the following items to illustrate the struggle between the United States of America and the Soviet Union: • Truman Doctrine • arms race/nuclear weapons • Korean War • NATO • Warsaw Pact • NORAD • Cuban Missile Crisis
c. **new nation–states have affected the role of the superpowers and international relations**	alignment revolution military intervention non-alignment independence	Briefly examine the impact of the emergence of new nations on international relations. Select at least one example to illustrate different effects; e.g.: • India and Pakistan • China (1949) • Vietnam • Israel
THEME III: INTERACTIONS IN THE CONTEMPORARY WORLD (1975–PRESENT)		
Students will be expected to understand that:	*Students will be expected to develop an understanding of the following concepts:*	*Students will be expected to use the related facts and content to develop the generalizations, key understandings and concepts:*
a. **the role of the superpowers changed in response to a variety of causes**	disarmament conflict management détente independence unification	Briefly examine changes that affected the superpowers: • tensions; e.g.: – Afghanistan – Central America • cooperation; e.g.: – arms reduction talks

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Generalizations and Key Understandings	Concepts	Related Facts and Content
THEME III: INTERACTIONS IN THE CONTEMPORARY WORLD (1975–PRESENT) (continued)		• changes in Europe – 1989 revolutions in eastern Europe and aftermath – re-unification of Germany • disintegration of the Soviet Union
b. **interdependence among nations is increasing**	interdependence globalization	Examine at least one current example of interdependence; e.g.: • European Union • international debt • new technology • multinational corporations • NAFTA
c. **individuals and organizations play a role in addressing international concerns**	environmentalism human rights humanitarianism	Examine at least one current example of how individuals and groups are attempting to solve international concerns and problems: • human rights movements • environmental movements • international conferences and organizations

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Skill Objectives

Skills have been organized into process, communication and participation categories, with inquiry strategies included to emphasize the fact that skills are interrelated and often developed together. This section contains a list of skills to be addressed in this topic; however, these skills may be interchanged with those listed in Topic A or addressed in both topics at this grade level. Skills are interrelated and should be integrated with the knowledge and attitude objectives in the instructional process.

Process Skills

Process skills help one acquire, evaluate and use information and ideas. These skills include gathering, organizing, interpreting, analyzing, synthesizing and evaluating.

Students will be expected to develop the ability to:

- **locate, select, interpret and organize information from print and nonprint sources**
- **interpret visual images and recognize cartoons and pictures as sources of information**
- **analyze information to determine accuracy and relevancy**
- **synthesize information gathered from a variety of sources**
- **evaluate the appropriateness of the process used to arrive at a decision.**

Communication Skills

Communication skills help one express and present information and ideas. These skills include oral, visual and written expression.

Students will be expected to develop the ability to:

- **deliver information in oral presentations with the aid of prepared notes**
- **defend a point of view in a written composition**
- **demonstrate learning by producing or displaying work, such as models, timelines, art work, cartoons or videotapes**
- **use prewriting strategies in the preparation and development of written work, such as brainstorming, concept mapping or outlining.**

Participation Skills

Participation skills enable one to interact with others. These skills include working effectively, individually and cooperatively, in group situations.

Students will be expected to develop the ability to:

- **contribute ideas confidently in a variety of group settings, such as brainstorming, class discussions and small group discussions**
- **work effectively with others in a variety of group settings**
- **participate in a group setting by assuming various roles, such as leader, participant, recorder or reporter.**

Inquiry Strategies

Inquiry strategies are combinations of skills that help one answer questions, solve problems and make decisions using process, communication and participation skills.

Students will be expected to develop the ability to:

- **use appropriate inquiry models to answer questions, solve problems and resolve issues regarding perspectives on global interaction**
- **develop a conclusion/solution to problems and issues related to global interaction**
- **assess evidence and evaluate solutions to problems and issues as to feasibility and desirability**
- **assess the impact of global interaction on their lives.**

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Attitude Objectives

The nature of social studies requires the examination of values and the encouragement of positive attitudes among students. While attention should be given to developing as many desirable personal characteristics and attitudes in students as possible, some attitudes need to be identified for particular emphasis in each topic. Students should participate in activities that help develop positive attitudes toward one another. Learning should take place in an atmosphere of free and open inquiry.

Students will be expected to develop:

- **an appreciation for the variety of perspectives and different solutions to an issue**
- **a desire to keep informed on issues that affect society**
- **an appreciation for the efforts of nations, groups and individuals to find constructive ways of resolving international differences**
- **a tolerance for the right of others to hold and express different opinions and attitudes**.

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